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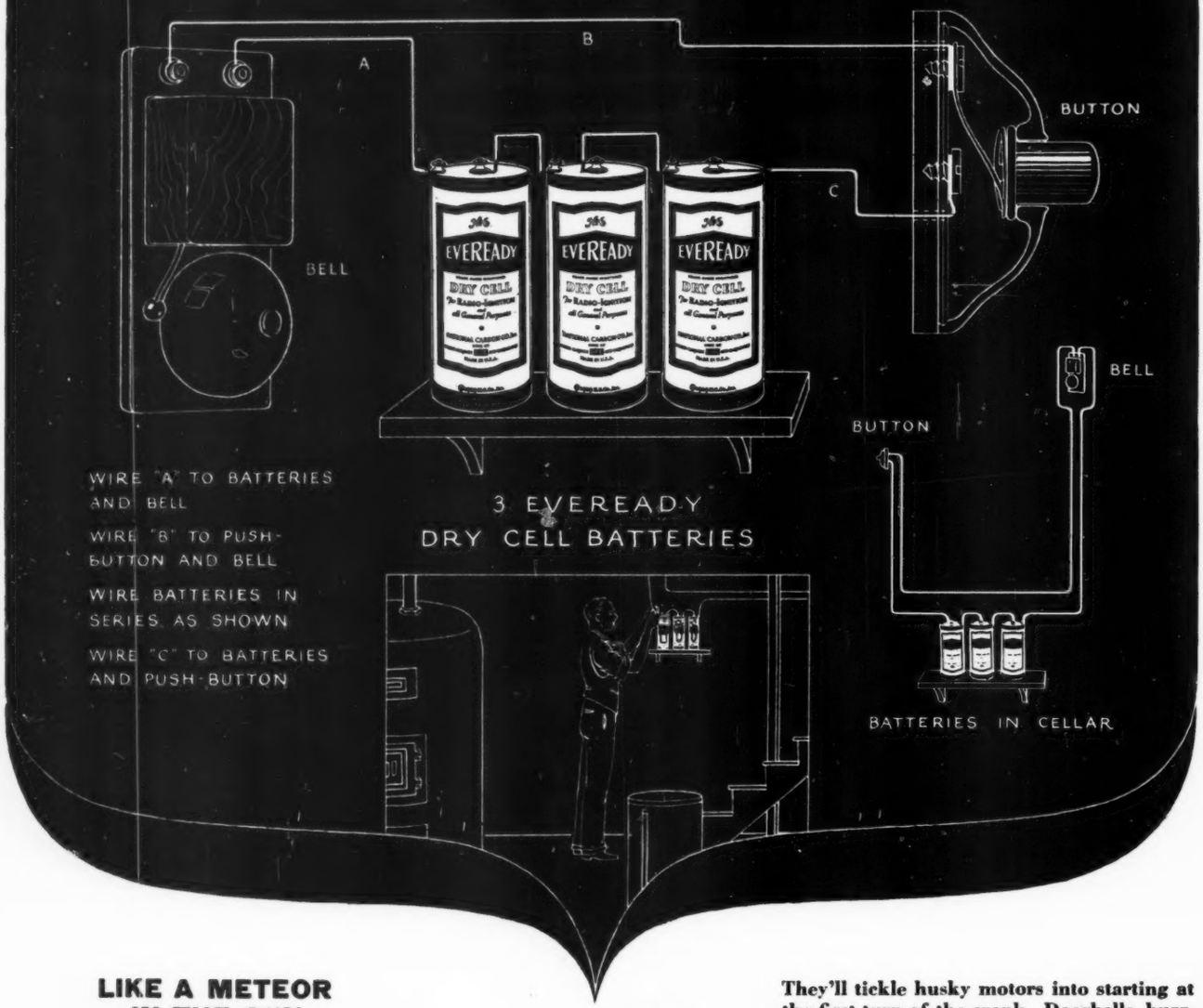

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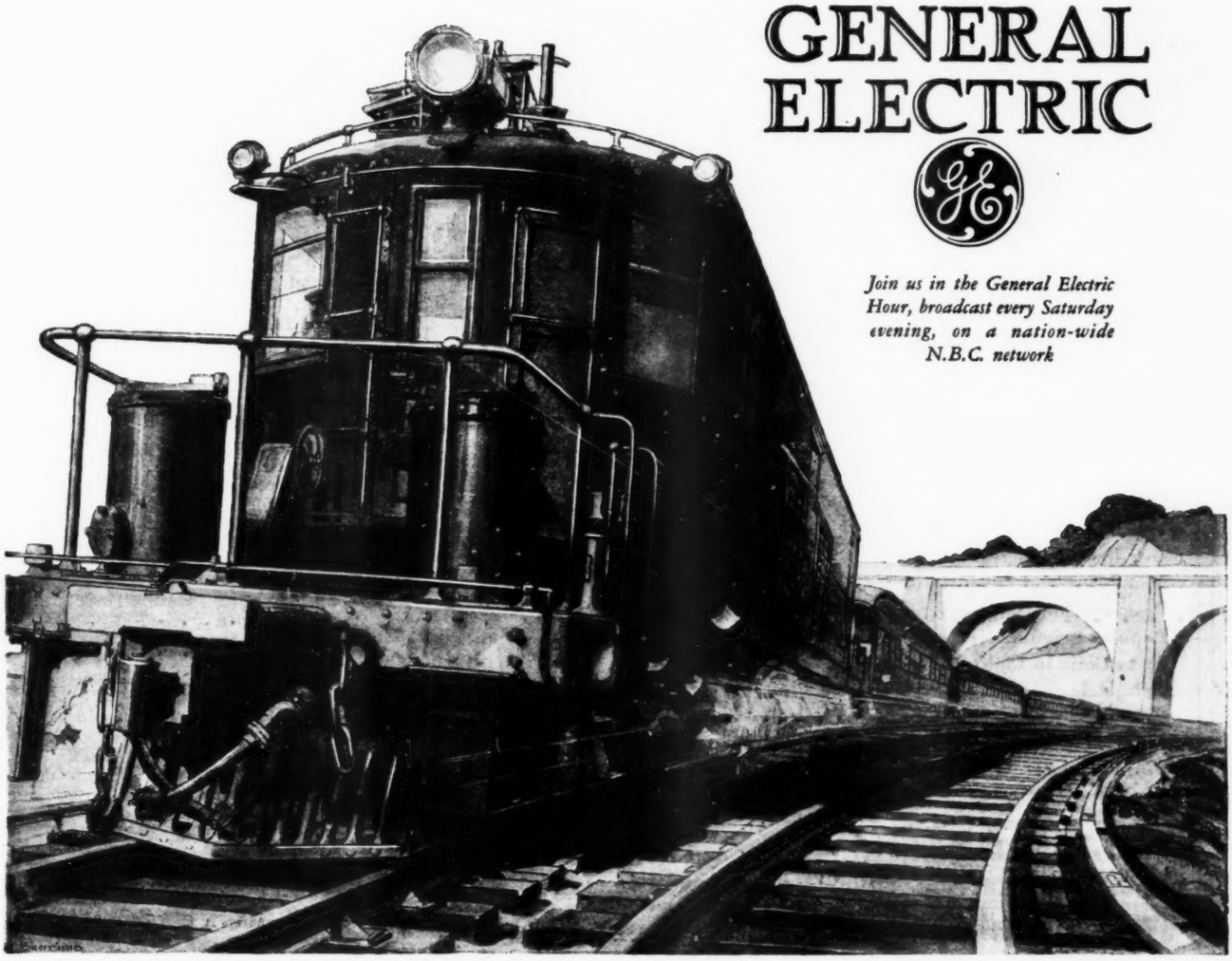

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POPULAR SCIENCE MONTHLY
381 Fourth Ave., N. Y. C.

The "Painless" Method of Building Your Own Home

LEON MEADOW, *Financial Editor*

"BUSY, George?"

"Hello there, Arthur. Come right in," boomed a voice from the depths of a very easy chair.

"Afternoon, George—thought I'd drop in for a few minutes, just to 'chin.' Say, you certainly do look like the contented country gentleman," Sommers added, sitting down in the chair opposite his friend.

"And why not," George Latham replied. "I mean that, without trying to appear smug—I am contented. Things have been sailing along pretty smoothly. I've done all my Sunday chores, sent Helen and the youngster over to her mother's for the afternoon—and there doesn't seem to be a reason in the world why I can't get out the old pipe, the old slippers, the torn sweater—and feel plumb contented."

"None at all, as far as I'm concerned. But—"

"Hold on," interrupted George. "Say Arthur, do you realize how badly you look—how worried you seem? Aren't you getting the benefits of a home of your own in the country? Seems to me, the last few times you've been over here with Laura—you've looked decidedly worried and distracted. What is it, old man? That is—if I'm not intruding."

"Heavens, no. As a matter of fact, I do want to talk to you about something, only I hate to be spilling my troubles in your lap."

"Nonsense, Arthur. I'm only too glad to be of assistance if I can."

"Well, look, George—it's about the house. The balance on my mortgage falls due in a lump sum soon, and I won't be able to meet it. Henderson, who holds this mortgage isn't particularly anxious to extend it. Says he's been holding the debt long enough as it is. And even if he does renew it, I realize now how futile it would be to keep going on like this. Now it's going to stand me more than I can afford to renew it, if someone condescends to do me *that favor*. Why, meeting the interest alone is strain enough—much less reducing the principal. And yet, five years ago, when I bought the house and took out that mortgage, I certainly thought that I'd have it paid off by now. But George,—I don't like this business of crying on your shoulder. Somehow, though, I've always wondered how you managed to swing your house and mortgage so nicely. I don't think you were earning any more than I when you first started to buy this place."

George Latham settled back in his chair and re-lit his pipe. "That is a bit of a mess, Arthur. But not quite as black as you've painted it. You know, from the few infrequent remarks of yours and Laura's, I've drawn an inference in my mind as to what seemed to be troubling you of late. I'm rather glad you mentioned it, because I feel that I can speak more freely now—whereas before it wasn't exactly any of my business.

"Helen and I thought about it a lot and we were pretty certain you folks weren't having an easy time. It occurred to me that you might have worked out a better savings and spendings plan if you'd been *forced* to save for your house."

"Guess that's so," admitted Arthur. "You know we had Laura's $2500 to put into the house, just after we were married."

"I thought so," continued Latham, "and my belief is that if you had had to save that much money in the first place, you would have realized how hard it would be to save it in the short space of five years. And also, that five years is too short a time to pay off a big sum like your mortgage debt—on your income. Then again, if you had to save that money, you probably would have found out about a building and loan association, where you draw higher dividends than the interest you might get from other types of savings institutions."

"Building and Loan Associations?" interrupted Arthur, "Why I never thought *they* made big loans. Dad had a membership in one of those little clubs when I was a kid."

"Not so little, any more, Arthur. There are 12,666 building and loan associations in the country today, with total resources of over $8,000,000,000 dollars—ready to help men like us. Remember that's just the mortgage end of it, without bringing in the question of high dividend rates on compulsory savings or the services modern building and loan associations are giving today.

"Just after we were married, Helen and I decided that we could never be happy in an apartment after we'd seen this spot. And there didn't seem to be another one like it anywhere. Well—to get back to mortgages—

"As accurately as I could figure it, the total cost of my home came to about $12,000. The price of the ground was $2,000 and the construction work close to $10,000. I applied to the Citizens Building and Loan Association for the first mortgage, because I had been a member of that institution for a long time, and I knew they were engaged in that type of financing.

"First they wanted to know if I could put into the purchase 25 per cent of the combined value of the house and lot in cash. They require that much equity to make the builder financially responsible and a safe risk to them. In other words, I was to contribute $3000. I referred them to my regular building and loan shares account, on which I had been drawing 6 per cent for (*Continued on page 5*)

The "Painless" Method of Building Your Own Home

(Continued from page 4)

about the last eight years. I had been depositing $50.00 a month, and my total savings were then over $6000.00. Incidentally, I certainly was glad that I had the wisdom, when I was younger, to make these compulsory deposits. They certainly brought me splendid dividends.

"Well, to get back—they then asked me for as much information as I could possibly give them concerning myself and my business record. After their own inspectors had gone over the property and our building plans, we decided upon a first mortgage of $7500. The next step was searching the title and drawing up the necessary papers. And that was that.

"We lived in town while the house was being built, and gratefully did without a lot of things to get a good start. The mortgage money was to be advanced in three parts. The first was to be paid when the roof was on; it amounted to $2500, and we only paid $25. for the next month or so, on it. The second part of the mortgage was advanced as construction neared an end, and then our monthly payment was doubled. And so, it was not until the entire mortgage was paid and we were actually living in the house, that we began to pay full monthly amounts." Latham stopped again to relight his pipe.

"And what is the full payment?" Arthur queried.

"$75.00—just 1 per cent of the total mortgage. Almost what we would pay for rent. But the beauty of the particular type of mortgage we have is its monthly reduction feature."

"What's that?"

"A type of mortgage that divides into payments on principal and interest. You see, interest at the rate of 6 per cent a year on the amount of the loan is deducted, and the balance applied directly to payment on the principal. The following month this same deduction for interest is figured *only* on the *unpaid* balance of the amount of the loan. So you see what happens. The interest charges constantly decrease as the sum credited to reducing the principal of the mortgage becomes greater. I believe they call it an amortization or pay-off mortgage.

"By the way, I think I have a booklet of theirs upstairs with a chart that shows exactly how this thing works. I'll be right down with it."

Latham came back a few minutes later. "Here it is Arthur, worked out on the application of a $10. monthly payment to a $1000 mortgage, carried to maturity."

No. of Months	Interest	Principal	Balance
12	$58.28	$61.72	$938.28
24	54.46	65.54	872.74
36	50.41	69.59	803.15
48	46.12	73.88	729.27
60	41.57	78.43	650.84
72	36.72	83.28	567.56
84	31.59	88.41	479.15
96	26.13	93.87	385.28
108	20.35	99.65	285.63
120	14.18	105.82	179.81
132	7.67	112.33	67.48
139	1.31	67.48	0

"Of course" Latham pointed out, after they had gone over *(Continued on page 6)*

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Or a monthly income as long as your beneficiary lives.

Send for the Facts

The plan above is for an income of $250 a month, payable at age 60. You may arrange to retire at other ages than 60 if you wish. You may provide for yourself a Retirement Income greater or smaller than $250 a month. Plans for women are also available.

Other things you can provide for by this program are: Money to leave your home free of debt. An income for your wife in case she should outlive you. Money to send your children to college. Money for emergencies. Money for special needs. There is hardly a financial problem which cannot be solved by this plan.

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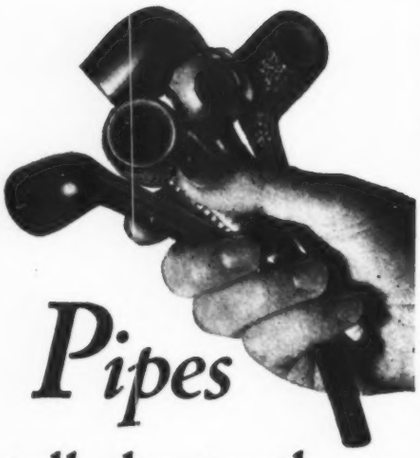

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My name_____

My street address_____

And the town and state_____

Now let the Edgeworth come! K-31

The "Painless" Method of Building Your Own Home

(Continued from page 5)

this chart, "the amount of each monthly payment is optional to the borrower. If he pays more, the amount credited to the principal is accordingly increased, and the interest charges for the succeeding months proportionately reduced."

"All of this sounds splendid, George" Sommers began, "but how does it affect me? My house is built, my mortgage already fixed. After all, I'm not starting out fresh, as you did."

"Well old man, I'm pretty sure that straight mortgage of yours can be converted into a building and loan type. Why don't you run down to see Foster at the Association tomorrow? He's a great friend of mine, be glad to help you out if you talk it over with him."

"I certainly shall. Do you really think they'll be able to straighten me out after the way I've messed things up?"

"Do I think so? Say, I'm willing to bet they will!"

"Lord! I didn't realize it was so late. Laura will be wondering what in thunder happened to her supper. I'm supposed to be out getting it now. I'd better move along. Listen, George—I owe you more than I can possibly express in words."

"Cut it short, and get along to the store. I understand how you feel about it. The pleasure's been all mine. So long."

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

SURPRISE YOURSELF WITH $3,000.00

SET aside $19.50 per month on the Investors Syndicate plan. Pay it along with your other monthly bills and you will scarcely notice it. 120 months from now you will find yourself with $3,000 cash in hand—built up by these small payments under the Investors Syndicate plan.

Larger or smaller amounts are proportionately easy to accumulate. 165,000 investors use this time-proved plan. Write for payment schedules and full details.

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Please send, without obligation, further information on Fidelity Bonds and a copy of "The Fidelity Investor."

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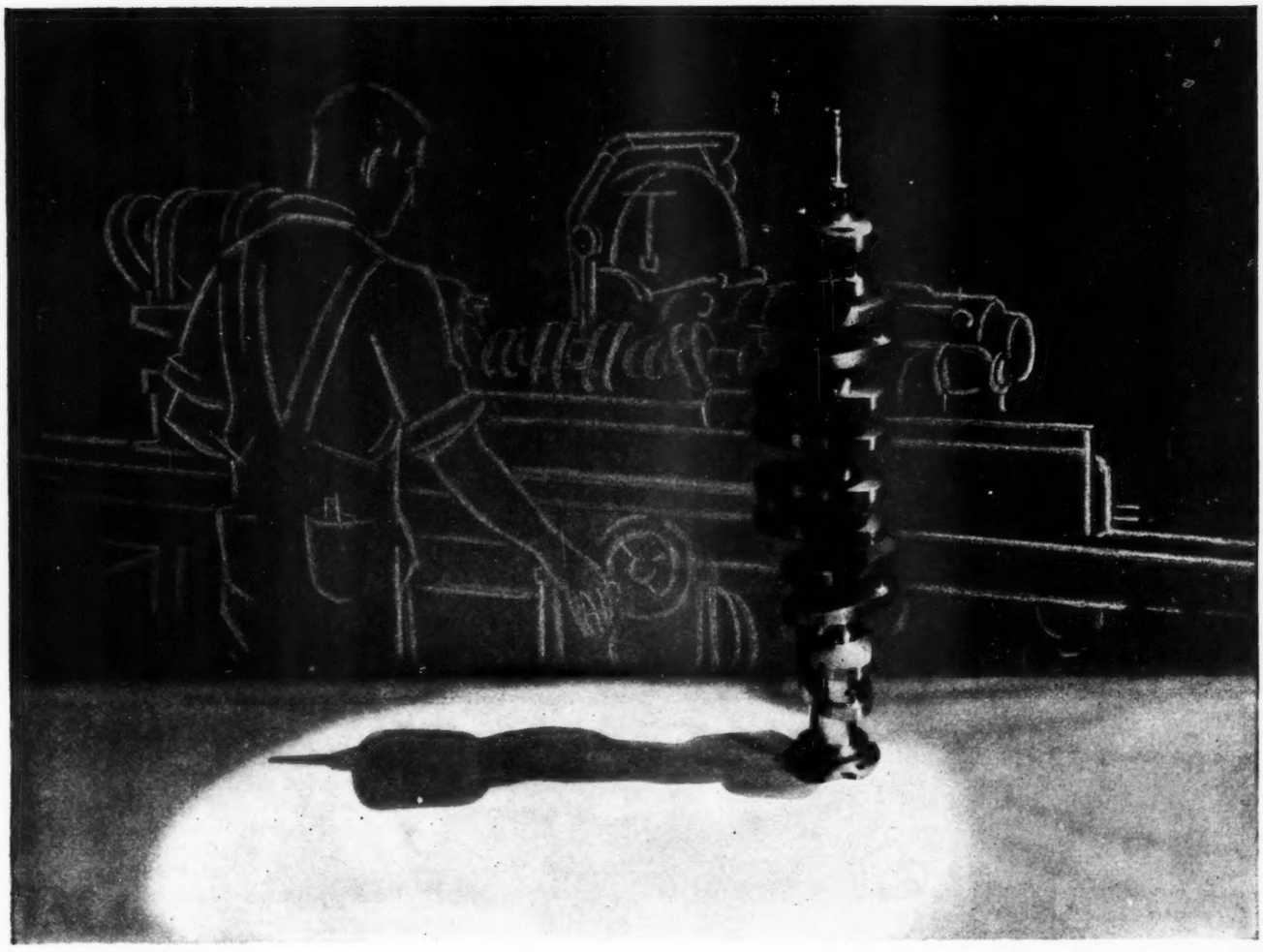


The automobile crankshaft is but one of thousands of machine parts made mechanically perfect on a quantity production basis by grinding.

Norton Company, Worcester, Mass., develops many special grinding machines to meet existing manufacturing requirements.

GRINDING WHEELS, GRINDING and LAPPING MACHINES, ABRASIVES FOR POLISHING,

NORTON

PULPSTONES, REFRACTORIES, POROUS PLATES, FLOOR and STAIR TILES, ABRASIVE AGGREGATE.

How to Pick a Heating System

Choose the Type of Plant That Suits Your *Requirements, Not Someone Else's*

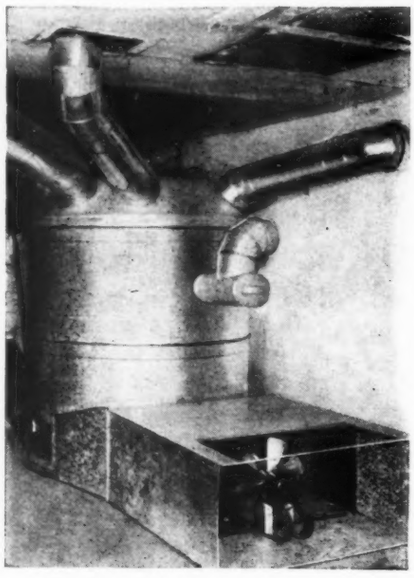
By COLLINS P. BLISS

Director, Popular Science Institute

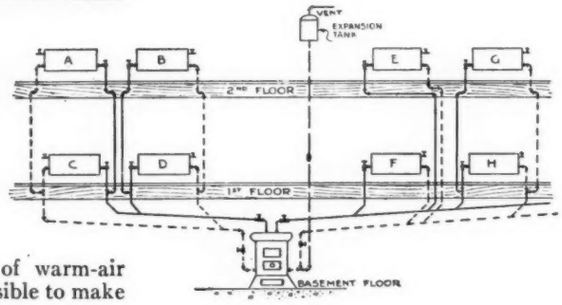
PEOPLE who are choosing a heating system are apt to argue over "which is the best" and forget that the important thing is to select the type of plant that fits their mode of living, their climate, and their house.

For instance, in many homes today there is no one in the house during the daytime, both husband and wife being at work. What is needed, in a case like this, is a system such as steam or warm-air that will give quick heat as soon as started up in the evening. Then, in a household where the care of the heating plant falls to the women members during the day, it is desirable to have a system such as hot-water or vapor that will maintain a steady, even heat with little attention. In those homes where it is the custom, at least once during the winter, to close everything up and take a vacation, a warm-air system proves particularly advantageous as there is nothing to freeze.

Consideration of such matters as weather conditions and the shape of the house should enter into the selection of a heating plant. Steam heat, for instance, is not the best choice for a mild and unchanging climate. This type of heat goes better with erratic, up-and-down temperatures. The man with a compact house, of moderate size, is in a better position to use a warm-air system than his neighbor with a large, rambling dwelling.



Above is a modern warm-air heater with electric fan intake to blow warm air to the registers. The diagram, at right shows a typical piping installation for a hot-water system.



A CAREFUL weighing, therefore, not only of the advantages and disadvantages of each type of system but of its suitability for the particular home in question, leads to the best choice. Warm-air systems have the lowest first cost, are flexible and responsive, and are simple and safe to operate. Such systems provide a certain amount of ventilation as well as heat and are particularly adapted to a humidifying arrangement. The absence of radiators with this type of heat conserves space and is desirable as far as appearance is concerned. Another advantage of warm-air systems is that they can be regulated to supply mild warmth for spring and fall.

However, warm-air systems are best for houses of limited size, unless a fan is used to force air circulation. Long leaders are impracticable, the maximum length being ten to twelve feet. When an oil burner is used with such a system, objectionable noise sometimes is transmitted through the ducts. Another disadvantage is that badly exposed rooms may be difficult to heat and, also, extreme care is required to keep the furnace casing and pipes tight to prevent coal gas and dust from entering the air flues. As to cost of operation, this varies so much with different types of warm-air installations that it is impossible to make a general statement.

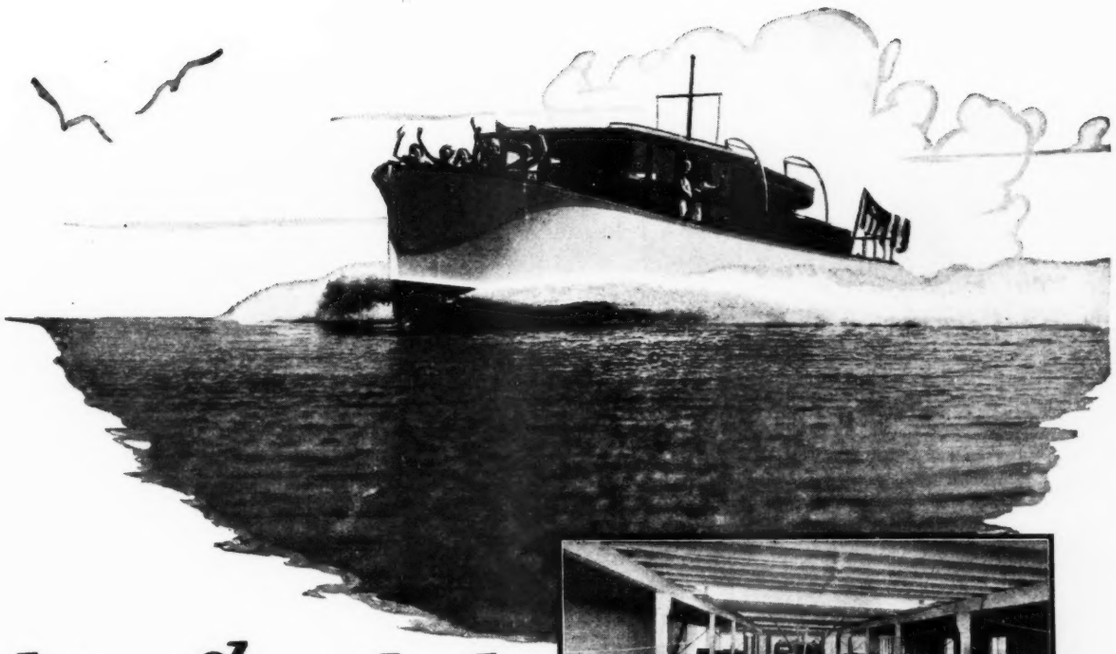
A STEAM system has the advantage of providing quick, sure heat when it is wanted and the installation expense is low, especially in one-pipe systems. Another advantage of steam is that small radiators are required and the piping layout is compact. Against these advantages are the following disadvantages: A steam system is not well suited to humidifying; there is the possibility of noisy operation such as "water hammer," particularly in carelessly installed one-pipe systems; and radiators cannot be controlled beyond turning them on or off.

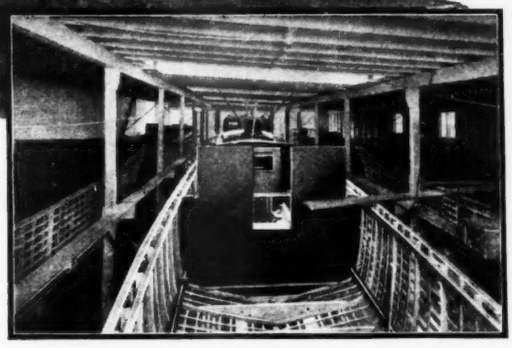
Vapor heat is especially adapted to changing weather, giving a speedy response to demands for heat. With this type of system, steam pressure need not be kept high, and there is great economy in operation since in mild weather it may be run at lower pressure. Radiators may be regulated hot, cold, or medium through valve control. Vapor heat is essentially mellow; the radiators are not as hot as in steam systems, and do not form "hot spots" in a room as readily. As to disadvantages, with this type of system there is a higher installation cost because of the special fittings required. Vapor heat is not suited to humidifying and the fact that large radiators are required is also somewhat of a disadvantage.

With a hot-water system, there is long-run economy and comparatively rare need for firing and attention, two decided advantages. Like vapor, radiators may be regulated to any desired heat and, also like vapor, hot water provides a mellow heat and radiators do not tend to form "hot spots." The chief disadvantage of a hot-water system is the high installation cost due to the large diameter double piping system that generally is used. Water pipes must be guarded against freezing. Hot-water is not well suited to humidifying and, as with vapor, large radiators are required. A hot-water system is not particularly quick in bringing up room temperature nor can it be shut down suddenly when a change to mild weather occurs.

REGARDED from a general angle, without respect to particular requirements or conditions, it will be seen that considering price the several types of heating systems have advantages and disadvantages that seem to about balance. However, in selecting a heating plant to be used in a certain house under certain conditions, it is possible to choose a system having advantages that are particularly valuable under the circumstances and disadvantages that are relatively less serious because of these particular circumstances.

TO SUPPLY readers with the many facts they should know about up-to-date methods and equipment for heating and ventilating, the Institute's engineers have prepared a thirty-eight-page booklet entitled "House Heating and Ventilating," which covers the subject quite thoroughly from the standpoint of the home owner. In this booklet, instructions are given on the operation and proper care of the different heating systems and also advice is supplied regarding the suitability of various fuels, comparative cost, etc. Readers who want this booklet can obtain it by sending twenty-five cents to Popular Science Institute, 381 Fourth Ave., New York, N. Y.





Cabin flooded— cruiser saved by *bulkheads* of Presdwood

In a terrific storm at Boothbay, Maine, a Fairform Flyer crashed on the submerged rocks of the Saco River Jetty entrance, where many a yacht and numerous lives had been lost. Water flooded the main cabin, but not a drop passed the watertight bulkheads of Masonite Presdwood. The boat stayed afloat—the engines kept running—and the cruiser was brought safely to port.

This crucial test justified the Huckins Yacht Corporation in their reliance on Presdwood. Like hundreds of other manufacturers they had found this grainless wood board exceptionally strong and remarkably resistant to moisture. They had found that its smooth surface took finish beautifully, that it was easily worked, could be cut, sawed or punched and did not crack, split or splinter. Now, in dramatic fashion, this grainless material vindicated the dependence placed upon it, by saving both cruiser and crew.

In industry after industry these same outstanding qualities of Presdwood make it almost invaluable. It builds highway signs and outdoor painted bulletins. It panels fine homes and modern apartments; is used in the construction of trays, tables, toys, clothes hampers, waste baskets, magazine racks, bird houses, beehives, motor truck bodies, kitchen cabinets, portable billiard tables and hundreds of other useful or decorative articles.

In constructing bridges, dams, skyscrapers and warehouses, Presdwood is often used to line the concrete forms. It leaves the surface perfectly smooth and hard and free from grain and knot marks. It makes drastic reductions in costs, eliminates the need of hand rubbing and greatly reduces the labor of making, installing and wrecking the forms.

Manufacturers, builders, contractors and home mechanics should read the fascinating story of Presdwood's manufacture. It is told in the Presdwood booklet which also lists eighty uses for this grainless wood board and tells how finishes are applied. The booklet is yours for the asking. Just mail the coupon *today*.

MASONITE CORPORATION, 111 W. Washington St., Chicago, Ill.

Masonite
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MASONITE STRUCTURAL INSULATION
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Please send me, Free, a sample of Masonite Presdwood and the Presdwood booklet.

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Our Readers Say

Ready to Fight for His Hypnotism

HAVE just finished reading the article on hypnotism by the magician Blackstone, and was strongly impressed with the unscientific approach to the subject. It was noticeable that every one of the tricks performed under the name of hypnotism were the favorites of magicians and tricksters.

It is now a well recognized fact that hypnotism is not a peculiar power possessed by a few select individuals. It is nothing but the knowledge of how to use suggestion effectively so that the subject induces himself to sink into one of various stages of sleep. The only control exercised by the hypnotist is self-control. I am defending hypnotism from Mr. Blackstone's attack because I know from personal experience that it exists.

I have carried out experiments in hypnosis with various persons as my subjects. The results obtained could not have been caused by ordinary suggestion. I sincerely hope that your readers will not allow themselves to be misled by Mr. Blackstone's article.—L. R. N., Evanston, Illinois.

Two-Shaft Elevator Works in Germany

O. L., of Fort Branch, Ind., wants to know, why not have two elevator shafts, one for up and one for down, with more than one cage to the shaft. Such shafts have been invented and are used. I remember one, the first one I ever saw, in the house where the American Embassy is located in Stuttgart, Germany.

This remarkable elevator consists of two shafts with a continuous string of cages. Anyone who likes can keep riding on it all day long, going up on one side and going down the other side. At the top and bottom points he will also have the sensation of going sideways in an elevator as it slides across horizontally from one side of the shaft to the other.—O. H. M., Taft, Calif.

Who'd Know if He Made a Mistake?

IN ONE of your recent issues I noticed a small item about memory.

Mr. L. A. Hazeltine, inventor of the famous neutrodyne radio circuit, was a member of my class at Stevens. My memory is good but I remember that as a test of pure memory Prof. Hazeltine memorized *pi* to one hundred and fifty places. He would stand at a blackboard before a group and correctly write it.—C. C., Bridgeport, Conn.

Nothing Like P. S. M. in Good Old England

AS A BRITISH reader of POPULAR SCIENCE MONTHLY, I feel I must congratulate you on your magazine. All the subjects you deal with I am interested in, especially airplanes. I am glad to say you give a part of your magazine to this subject. I have tried many publications over here but I have not found one to equal yours. I think the people in America are a lot more interested in airplanes than are our people over here in England.—R. H., Bolton, England.

Maybe That Old Fear Would Be Good for You

YOU'VE taken a big worry off my mind, and I have to thank you for doing it. I have great confidence in old Doc Free, and it sure was a relief to learn, on his authority, that the hooch today won't kill me any quicker than the stuff would back in the prehistoric days. From now on you get my vote, always, and whenever I celebrate I'm going to carry a copy of POPULAR SCIENCE MONTHLY around with me to make me feel better and keep me from being afraid of getting poisoned.—A. C. L., Des Moines, Iowa.

His Two-Year-Old Model Still Going Strong

WE STARTED a model airplane club in our town in the fall of 1928. About this time I built the model endurance plane shown in your magazine. This model is still doing its usual grind and I believe it has had more hours in the air than most planes. On one occasion it was caught by air currents and made an altitude of about one hundred feet. Later I found it about a quarter of a mile away undamaged. I think your magazine is the very best all around on science to be had.—R. N., Blissfield, Mich.

Setting Them All Right on the Airplane Wing Lift

IN THE May issue of POPULAR SCIENCE MONTHLY was published an article by T. R. L., of Worcester, Mass., relating to the subject of lift on an airplane wing. T. R. L. made reference to another article by R. A. L. in a previous number on the same subject.

I claim T. R. L. and R. A. L. are both wrong. If T. R. L. claims the under surface of the wing produces two thirds of the lift, would he please explain why so much care and thought is given to designing the upper wing surface, and none to speak of to the lower surface. The reason is because the upper surface of an airplane wing produces the most lift.—A. W., Wollaston, Mass.

Try Your Wits, Not Your Pencils, on This One

ABOUT 1903 or '04, when the country was trying with might and main to find out the age of Ann, I wrote an age problem which, to the best of my knowledge and belief, has never been worked or published. It is this: A boy being asked his age replied, in this manner: "I am now three times older than my brother's age nine years ago." How old is the boy?—L. D. L., Pottsville, Pa.

We Know Many Fighters Who Won't Like This Idea

AIR-PADDED boxing gloves, described in the May issue of POPULAR SCIENCE MONTHLY, make a hit with me. I got a suggestion to make, if you think it's worth space in the world's best magazine. Here it is: Have a law making every prize fighter wear these air-padded gloves. Below the belt, in the foul region, have tacks with the points out. If a fighter lands a blow down there, the tacks puncture his glove and the air comes out with a hissing sound. Then even the referee will know a foul has been struck. Wouldn't that help the foul epidemic? (Page Mr. Scott.) Or maybe if these tacks were about a foot long, it might keep the fierce scrappers from wasting so much of the fans' time in clinches. Does this sound good to you?—R. F. F., Los Angeles, Calif.

We Aim to Please; Send Us Your Vote

I AM a steady reader of the POPULAR SCIENCE MONTHLY and I am always anxious for the next number. I like the POPULAR SCIENCE MONTHLY better than any other magazine. I like the home workshop department best, although the other departments interest me.

I am especially interested in model making of all kinds. I say why not have a vote on what the people like best and increase that department to the fullest extent.—E. M., Alton, Iowa.

Here's One Earnest Plea for Standard Sized Faucets

DIDN'T I once hear of some such body as the American Engineering Standards Committee, which went around getting manufacturers to turn out fire hose and movie films and other things in standard sizes? If so, I certainly wish they would get after the

A *new* Service Policy *for* Oakland-Pontiac Owners

WHEN you buy an automobile, four things are essential if you are to enjoy completely satisfactory ownership: The car must be designed and built right. It must be delivered to you by the dealer in proper condition. It must be inspected by the dealer during the initial driving period. And thereafter it must be inspected by the dealer periodically to make certain that it is thoroughly oiled and greased and all moving parts are operating properly.

The Oakland Eight and Pontiac Big Six are outstanding examples of sound engineering and careful manufacture. And the Oakland Motor Car Company through its dealer organization has made full provision to assure your enjoyment of these inherent advantages for many years.

Throughout the United States are thousands of competent Oakland-Pontiac service organizations. The efficient service they render has been of value to owners everywhere. And now, to provide an even broader, more helpful service, Oakland and its dealers have inaugurated a new Owner Service Policy.

When you take delivery of your car, the dealer will hand you this policy in printed form—backed by both himself and the Oakland Motor Car Company.

Under its provisions there is *no charge for labor or for parts* replaced under the standard warranty which covers a period of either 90 days or 4000 miles, whichever occurs first. And this service will be rendered by any Oakland-Pontiac dealer anywhere in the United States upon presentation of the owner's identification card.

There are other features of the policy which make for satisfaction from the start. Your car is thoroughly inspected, adjusted and lubricated before being delivered. Then, during the initial driving period the dealer making delivery gives *two free inspections and adjustments* to make certain that all vital parts are working properly.

At the end of 500 miles he will give your car a road test; check and adjust the ignition, the carburetor and timing; inspect the lubricant in the engine, rear axle and transmission; adjust the brakes; and test and fill the battery.

At the end of 1500 miles there is another group of inspections and adjustments—which constitute a precautionary rechecking to insure satisfactory service. These include road testing; aligning front wheels; tuning the engine; checking and adjusting brakes, steering gear and fan belt; checking the radiator, tire inflation and the operation of lights; tightening all body and chassis bolts; testing and filling the battery; and giving the car a complete oiling and greasing. All of these operations are performed without charge except for the oil and grease used.

And finally, the dealer will provide, at regular 90-day intervals, the exclusive Oakland-Pontiac 3-Point Free Adjustment Service which comprises checking and adjusting the ignition, carburetor and timing.

* * *

This new service policy is still another reason why you should investigate Oakland or Pontiac before you buy any car in either price class. It provides definite protection to your investment. And it affords the best possible evidence that Oakland Eight and Pontiac Big Six are cars of high quality. For such a service policy could be applied only to cars that are soundly engineered and built of fine materials to exacting standards of accuracy.

OAKLAND MOTOR CAR COMPANY

Pontiac, Michigan

fellows who make kitchen and bathtub faucets, now that so many different kinds of gadgets are made to attach to them. The other day I bought a nice new dishwashing attachment, one of the spray kind with a hose that clamps to the faucet. It didn't fit the faucet, and when I turned on the water I got a shower bath. Now that I'm faucet-conscious I see different shapes and sizes in every home I visit. Why isn't something done about it?—(Mrs.) P. G. M., Morristown, N. J.

How Long Has This Gliding Been Going On?

LISTEN, Mr. Editor: Don't go sour on this gliding stuff. That's my weakness now. I used to be a speed artist in the old made-over car. And boy I could make that can rattle! Now I'm all hot and bothered about this gliding. I'd rather glide than eat—almost. I've made a glider all my own self. Maybe the Government wouldn't O.K. it, but when she gets into the air she's got a bird looking like an amateur. If there's anything in the world that's more fun than gliding—don't lead me to it. I'm crazy enough now. I hitch the bird behind the flivver and drag her to the top of the hill. With a bunch of boys, each of whom hopes that sometime maybe I'll let him have a ride, on the shock cord, away we go! Haven't smashed anything yet but a few fence posts, but I'm still hoping. You tipped me off to this thing, and I'm yours for life, and I don't mean maybe. —F. D., Lenox, Mass.

Plans Wanted for Model of the Rocket

YOUR article on the *Diamond Tally-Ho* went over with a bang with me. I believe it's the most interesting model we've had to date. I'm wondering if we couldn't have more articles along the same lines. Personally, I would like to see plans of Stephenson's *Rocket*, as illustrated in the picture section on page 63 of the April issue. I should like to see it built about the size of the *Diamond Tally-Ho*. Several years ago I saw plans of this locomotive but cannot find them now. Do you know where they might be obtained? Another model I would like to build is a modern express cruiser. The one I have in mind is the sixty-five-foot Sunbeam cruiser built by The Great Lakes Boat Building Corporation of Chicago. I have really no idea in what manner to approach them for prints. Can you suggest a way? I'm really enthusiastic about model making and wish I had more spare time to devote to it.—O. M. S., Williamsport, Pa.

Shall We Take Out All the Boosts?

IN YOUR reply to C. R. L., Fargo, N. D., April issue, you say you have not sufficient space for the large number of interesting letters you receive each month. Why not expunge all those letters that are only propaganda for your magazine, but do not interest the readers? In the latest number of POPULAR SCIENCE MONTHLY you insert as many as ten of them.—G. S., Puerto Plata, Dominican Republic.

Read and Let Read, That's His Motto

IN "OUR Readers Say," I notice a letter from B. M. R. wanting aviation articles cut out and others want some other section deleted. If you did as everyone wants, cutting all they say, the only part of your magazine left would be "Our Readers Say," because every one likes that. I'm interested in aviation and I don't care a hoot about stage-coach model building, but I like to read about it and see what other people like. I think that those who want parts of POPULAR SCIENCE MONTHLY cut out are pretty darn selfish and are thinking only of themselves and not of the other million or more readers who surely have a right to be considered as well as those who object.—N. J. M., Lockport, N. Y.

Built Bluenose *And Glad He Did It*

I HAVE built the model *Bluenose*. Started it in November and finished it today, using spare time. My work was arduous, but being interested, I carried the job to completion. The plans I got from you were exact and most useful—indeed, necessary; and the directions in the four issues of the magazine were painstaking, and I constantly consulted them. I don't think anyone could do without both if he or she intended to make a real reproduction. I thank you for the opportunity to have produced a thing that shows a splendid type of seagoing, modern, useful sailing vessel, and of the art of man in developing the best means of dealing with two forces of Nature—sea and wind.—A. E. S., New York, N. Y.

He Just Revels In His Escape Tricks

I AM A boy thirteen years of age. I have read your magazine for over three years and I believe it is the finest magazine of its kind published. I am particularly interested in aviation and magic. The article called "An Escape Trick" and "Envelope Mystery" was especially good. At the present time I am planning a model airport which is going to contain many novel features. I wish you would publish more articles like the one called "How to Whittle a Toy Seaplane," in the March issue. I would suggest that you publish two or three of these planes a month instead of only one. Why not put in a Ford and a few planes like that? But whether or not you are able to act on my suggestion in this matter I still wish you the greatest success with your wonderful magazine.—J. W. W., Jr., Albany, N. Y.

Do You Think We Deserve This Scolding?

WHERE do you get the idea that bootlegging hooks up with POPULAR SCIENCE? It's popular, all right, but where's the science? You might as well write about the fellows who sit on flagpoles or the six-day bicycle race. That flagpole idea might be a good thing at that for some psychological bug. This is just a tip to tell you to watch your step. We don't want to get dizzy on "white mule" every time we read POPULAR SCIENCE.—J. B. W., Topeka, Kansas.

Another Little Problem!

HERE'S another problem for your mathematical fiends: A suitcase is twenty-six inches long, fifteen inches high, and seven thick. Can a thirty-two-inch umbrella be packed in it? After all, it's easier than the board problem.—W. R., Defiance, Ohio.

Better Watch Out; More Are on the Way

THANKS for the movie article in May POPULAR SCIENCE MONTHLY. Give us more of that kind of stuff. Part of it I could almost understand. I'll bet Mr. Mok himself doesn't know what the Schufftan process is all about. I tried to work it out with a hand mirror, a shaving mug, and a kodak. It wouldn't come right; but I broke the mug, the little woman got sore, and I cut my finger. A good time was had by all. Give us more articles like that. They make for domestic peace and help pass the time away.—R. C. McC., Buffalo, N. Y.

Everybody Agree with Him?

I THINK you should run more articles on aviation and less on building furniture. I have been taking POPULAR SCIENCE MONTHLY for nearly two years, and would not miss one copy of it for two of any other publication that I have ever sat down and tried to read.—W. L. L., Kynesville, Fla.

Strong for Gus and Joe

I ENJOY the Gus and Joe department in POPULAR SCIENCE MONTHLY. It ought to be read by everyone who drives a car.—H. T., Los Angeles, California.

Let the Shouters Do the Fighting

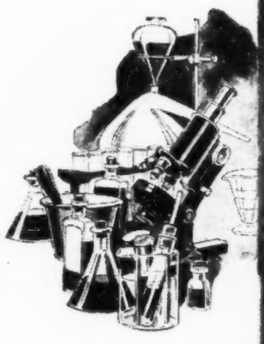
REPLYING to the letter by G. P. H. in the April issue of POPULAR SCIENCE MONTHLY, it seems to me that the Navy Department has demonstrated that aircraft, in general, can protect our coast at a minimum expense and risk of man power. There is no need of trying to make war more horrible, as those who saw actual service will testify. Those who insist on expensive protection should prepare to pay for it and be ready to take part personally in the struggle.—G. B. C., Washington, D. C.

Just Another Cry for More Puzzles

PLEASE continue your puzzles, as I think they are very interesting. I have been unable to walk for over a month and have found great pleasure in making your puzzles. The one of eleven pieces I made out of cigar box parts. The cross I cut out and glued upon another piece. This makes a fine frame to build the puzzle on. I found it was possible to make another puzzle with the same pieces, and all who have tried it claim it is harder than the cross.—W. Z., Cleveland, Ohio.

Popular Science MONTHLY

JULY, 1930 RAYMOND J. BROWN *Editor* VOL. 117, NO. 1



Across the social peace and security of the world falls the shadow of the hand of crime. New hope for removing this blot lies in the successful treatment of crime-producing diseased glands.

Crooks Cured *by* Surgeon's Knife

Here for the first time is the amazing story of how criminals in San Quentin prison, California, are made honest by giving them healthy glands.

By H. H. DUNN

THE surgeon's knife and the laboratory test tube have entered the campaign against crime. Experimental researches, carried on over a number of years and beginning to show results in control and reform institutions this summer, indicate that criminal tendencies may be eradicated, development of the criminal averted, and the established criminal restored to normal by medical and surgical treatment.

Most of the work which has resulted in this astounding discovery has been done in schools for "backward," or "wayward," children in San Francisco, and among the inmates of San Quentin prison in California. Looking into the causes of criminal behavior, Dr. Ralph A. Reynolds, of San Francisco, has opened a door which apparently leads not only to the prevention of crime, but to the reformation of the adult criminal. Confirmation of the value of the method of treatment of criminal tendency by surgery and medicine awaits the test of time, but in the five years so far devoted to this work results have been achieved which indicate that the surgeon may take the place of the policeman, the physician that of the judge, and that civilization will *prevent* rather than *punish* crime.

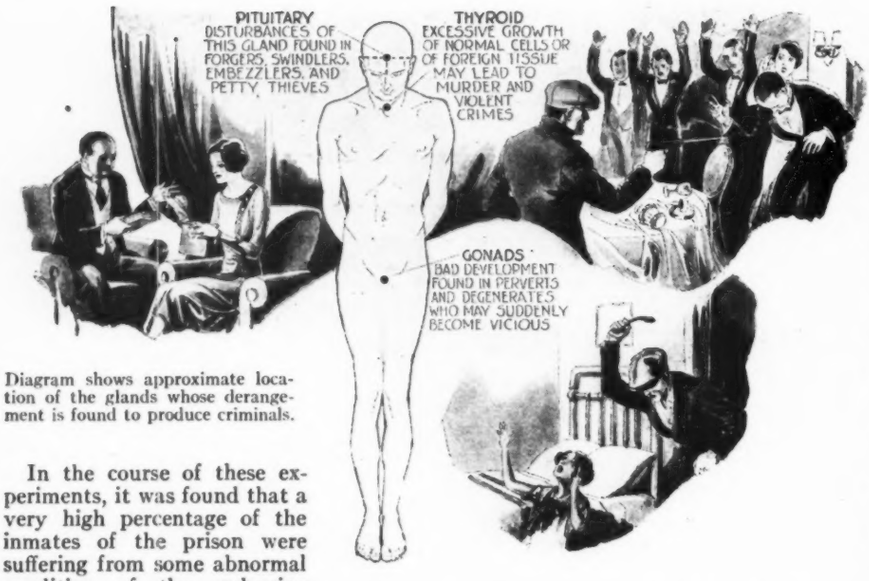

PITUITARY
DISTURBANCES OF THIS GLAND FOUND IN FORGERS, SWINDLERS, EMBEZZLERS, AND PETTY THIEVES
THYROID
EXCESSIVE GROWTH OF NORMAL CELLS OR OF FOREIGN TISSUE MAY LEAD TO MURDER AND VIOLENT CRIMES
GONADS
BAD DEVELOPMENT FOUND IN PERVERTS AND DEGENERATES WHO MAY SUDDENLY BECOME VICIOUS

Diagram shows approximate location of the glands whose derangement is found to produce criminals.

In the course of these experiments, it was found that a very high percentage of the inmates of the prison were suffering from some abnormal condition of the endocrine or "internally secreting" glands, which empty directly into the blood stream. It was learned that perpetrators of crimes of violence showed disturbance of the thyroid, the twin gland in the front of the neck which regulates growth, while forgers and similar criminals against property were found to have abnormal conditions in the pituitary. This is a pear-shaped body about the size of a bean, lying at the base of the brain. Perverts and degenerates hid certain derangements of the sexual glands under apparently normal exteriors.

Working with Dr. L. L. Stanley, San Quentin prison physician, Doctor Reynolds found that beneficial results were obtained, both in physical condition and mental outlook, when the glandular derangements of these prisoners were corrected. Approximately sixty were so treated by operation and by administration of gland extracts. Not one failed to respond to the treatment.

THESE results with adults in the penitentiary led to two conclusions, the most important that have been made in the scientific study of crime:

First, that the so-called "criminal instinct" may be removed from the minds of men, and women, by the study and treatment of the endocrine-gland systems, in childhood or later.

Second, that potential criminality may be eliminated by the treatment of these glands in youth, whenever and wherever children are found to be suffering from such abnormal conditions.

In other words, it now seems not only possible, but highly probable, that malsecretion (that is, a secretion which is too large or too small, or chemically unbalanced) of some gland is responsible for the greater part of the crime in the world.

"We are beginning to accept the fact that the criminal is not essentially 'bad'," said Dr. Reynolds, "but that he merely is a person who shows a departure from what society has established as the 'normal.' There is a growing belief among scientists that, in dealing with criminals, too much attention is paid to the mind and the emotions, and too little to the *sources from which the mind and the emotions arise*, and by which they are controlled.

"On the reasonable assumption that these sources exist in the functions of the body itself, and more specifically in the chemical functions of the body, the next logical step is to find the mechanism which controls the body's chemical activities.

"Evidence is that this mechanism exists in the endocrine glands—the glands of internal secretion, also known as the 'ductless' glands, because their cells secrete directly into little blood vessels in the glands, without the aid of ducts. In connection with this reasoning, it appears quite obvious than any unbalanced condition of the chemistry of the body will lead to various and varying forms of unbalance in the mental and emotional outlook, and in the conduct (i. e., behavior) of the person involved.

"THE work at San Quentin, of which more later, leads logically to a study of the field from which all criminals are drawn—our children. It would be tremendously more advantageous to society to *prevent the development* of the criminal, than to *reform him* after he is developed. Aside from the saving to humanity, the economic value to civilization of the salvaging of young lives, and the conversion of young minds to useful occupations, cannot be estimated.

"My work has taken me into the medical direction of two institutions, involving about 200 children. In virtually every 'backward' or 'wayward' child, boy or girl, I have been able to see a *physical* departure from normal. In many that as yet are neither backward nor wayward, I see evidence of the future development of abnormal conditions in the gland system. There is the child of low, often moronic, mind, who can do good work with his hands, but not with his brain. He is mistrained, and, because his mind does not respond to the training given him, he is called a 'dumb-bell' or worse. He goes out into the world unprepared to earn what the world calls an 'honest living.' He is drawn into a 'gang.' He is involved in a hold-up, or a gang-fight. The law gets him, and he—with an antisocial inclination in his subnormal mind—becomes a criminal.

"Such a child should be discovered; his ancestry traced; his physical and mental history recorded; the *cause* of his mental condition found. He may not be—in fact, he often

Above, a criminal of a dangerous type, the result of growth within the thyroid gland. Below that is the gonad type, liable to commit crimes of perversion. At the right, pituitary type, a petty thief is shown.

Just a few of the physicians from all parts of the world who have called at San Quentin prison in California to observe the work of Drs. Reynolds and Stanley. Dr. L. L. Stanley is seen in the insert at left.

is not—an obvious 'gland case,' but in many, many instances he will be found possessed of an abnormal thyroid or pituitary gland, and back of him will lie a history of ancestors similarly affected.

"Now, many children who show visible endocrine disturbances have pleasant types of minds, never brilliant, often below normal; but usually best described as 'fat and good-natured.' Their obesity or extreme fatness can be reduced by the correction of their glandular disturbances, and with such reduction comes an increase in industry and ambition. The moronic mind cannot be improved, but it can be given a sound body, and it can be given the training for work with the hands which will enable its possessor to win and maintain an honest place in society.

"What we must learn about children is why one becomes a criminal and another does not. Then we must treat the subnormal child—by medicine or by surgery—to restore the chemical balance of the body. This done, we must prepare him, or her, to earn an adequate living, so that the economic incentive to crime—as well as the mental receptivity to criminal ideas—may be removed. *By so doing, we shall prevent crime.* Indeed, we are so preventing it, in the schools mentioned.

"It seems to me essential, as the first step in this program, that orphanages and other schools containing numbers of children whose heredity and early environment may have been unsatisfactory should segregate the problem-children for study and treatment. Certainly, children so cared for could not be harmed, while the opportunity for their improvement is tremendous.

"THERE can be no question that in the majority of instances, malsecretion of some one or more of the endocrine glands is responsible for the commission of crime. To return to the experimental work at San Quentin prison, we have traced certain criminal activities directly to certain glands.

"The treatment of these glands has resulted, in many instances, in marked mental and physical improvement of the criminal, and, moreover, in what bears every evidence of being the *elimination of the tendency to commit crime.*

"THE principle involved is the restoration of normal mentality through establishment of chemical stability in the body by the treatment of the gland, or glands, involved.

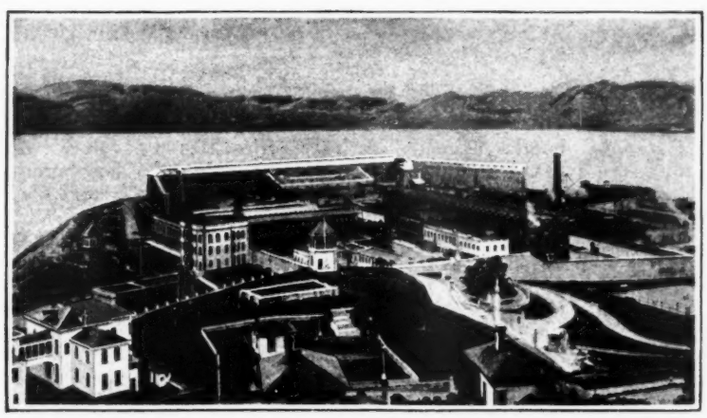
"Some time ago, with the coöperation of Doctor Stanley, I undertook to carry through to conclusion a series of studies and treatments of prisoners showing gland disorders. Among these were men with enlargement of the thyroid gland, the very fat, the very thin, the very tall, the very short, those having abnormal hair distribution and growth, and some with subnormal sex glands.

"The thyroid group was divided into three classes:

"First, those having an excessive growth of the normal cells of the thyroid gland, resulting in a highly active, 'nervous,' and emotionally unstable mentality. This condition is known as 'hyper plasia,' or overgrowth.

"The second class consisted of those having tumorous or lumpy growths of foreign tissue *within* the thyroid gland. This growth secretes a poisonous substance into the blood stream, resulting in great excitability, emotional instability, increased bodily activity, and, frequently, periods

(*Continued on page 132*)



San Quentin prison, California. It was here that Drs. Reynolds and Stanley made their sensational gland tests which have led to the reformation of dangerous crooks.

Talk, Hear, SEE on This Phone

Two-Way Television Is Demonstrated in Laboratory As an Engineering Stunt

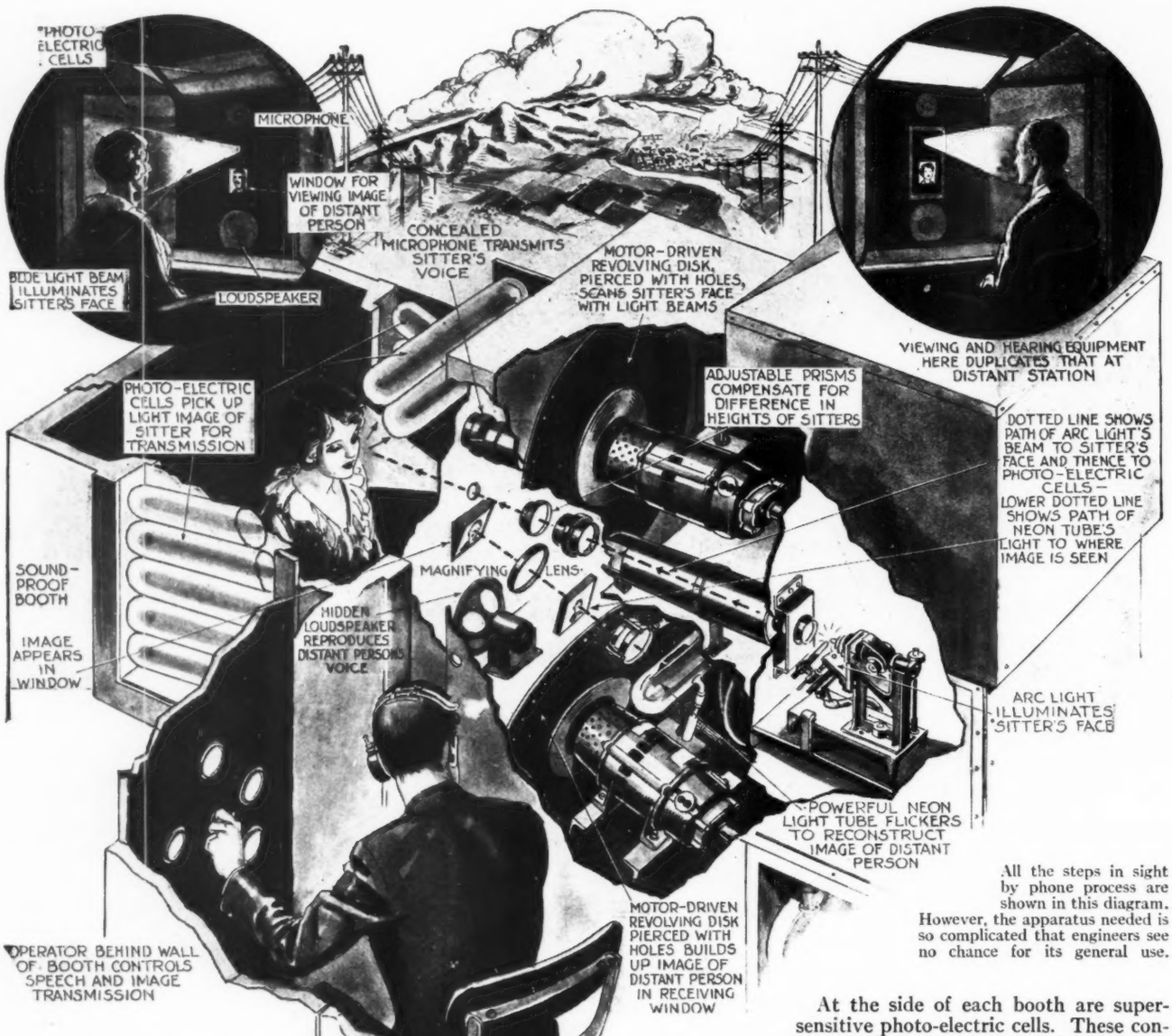


PHOTO-ELECTRIC CELLS
MICROPHONE
WINDOW FOR VIEWING IMAGE OF DISTANT PERSON
CONCEALED MICROPHONE TRANSMITS SITTER'S VOICE
MOTOR-DRIVEN REVOLVING DISK, PIERCED WITH HOLES, SCANS SITTER'S FACE WITH LIGHT BEAMS
BLUE LIGHT BEAM ILLUMINATES SITTER'S FACE
LOUDSPEAKER
VIEWING AND HEARING EQUIPMENT HERE DUPLICATES THAT AT DISTANT STATION
ADJUSTABLE PRISMS COMPENSATE FOR DIFFERENCE IN HEIGHTS OF SITTERS
PHOTO-ELECTRIC CELLS PICK UP LIGHT IMAGE OF SITTER FOR TRANSMISSION
DOTTED LINE SHOWS PATH OF ARC LIGHT'S BEAM TO SITTER'S FACE AND THENCE TO PHOTO-ELECTRIC CELLS — LOWER DOTTED LINE SHOWS PATH OF NEON TUBE'S LIGHT TO WHERE IMAGE IS SEEN
SOUND-PROOF BOOTH
IMAGE APPEARS IN WINDOW
MAGNIFYING LENS
HIDDEN LOUDSPEAKER REPRODUCES DISTANT PERSON'S VOICE
ARC LIGHT ILLUMINATES SITTER'S FACE
POWERFUL NEON LIGHT TUBE FLICKERS TO RECONSTRUCT IMAGE OF DISTANT PERSON
MOTOR-DRIVEN REVOLVING DISK PIERCED WITH HOLES BUILDS UP IMAGE OF DISTANT PERSON IN RECEIVING WINDOW
OPERATOR BEHIND WALL OF BOOTH CONTROLS SPEECH AND IMAGE TRANSMISSION

HOW TELEVISION EQUIPMENT WORKS AT ONE END OF THE TWO-WAY LINE

Drawn Especially for POPULAR SCIENCE MONTHLY *by B. G. Seielstad*

All the steps in sight by phone process are shown in this diagram. However, the apparatus needed is so complicated that engineers see no chance for its general use.

SEEING, as well as hearing, the person on the other end of the phone line has been accomplished in the laboratory. Two-way phone television was demonstrated recently by the Bell Telephone Laboratories in New York City with the aid of complicated and expensive apparatus.

Engineers, however, hold out no hope at present of improving the television apparatus to the point where sight and hearing will be possible in ordinary telephone conversations.

Our artist shows above how two-way television is accomplished. Each of the "parties" sits in a specially prepared booth. Directly in front of each is a panel, at the top of which is a special microphone. Below that is an opening through which comes the beam of light used to "analyze" the face for the television. Below this opening is a small ground glass screen on which appears the image of the "party" at the other end of the line, and at the bottom of the panel is a loudspeaker. The microphone at the top and the loudspeaker at the bottom take the place of the ordinary telephone, which cannot be used because it would hide part of the talker's face.

At the side of each booth are supersensitive photo-electric cells. These convert the light impulses that fall on them into electric currents. Behind the panel is an arc light which projects a beam through a series of lenses. In the path of this beam is a metal disk pierced with holes arranged spirally. The disk revolves eighteen times a second and each hole permits a tiny beam of light to sweep across a different portion of the sitter's face.

This light, when reflected by the beam from the sitter's face to the photo-electric cells, varies to conform with the lights and shadows of the face. The result is a rapidly pulsating current. This current is carried by wire to the receiving apparatus at the other end of the line where, after amplification, it is transformed from electrical vibrations to corresponding

(*Continued on page 123*)

Just before the jump! Buddy Bushmeyer climbs out of the cockpit of an airplane and takes his stance on the lower wing ready to hurl himself out into space sometimes a mile above the earth.

At left, Bushmeyer has jumped clear of the plane and is beginning the long swift fall that precedes the pulling of the rip cord of his parachute. Above, the plane he has just left is seen and near it is the dare-devil of the air, his 'chute still unopened as he hurtles with high speed toward the earth, which is marked by roads and trees, a breath-taking distance below him.

Jumping *from the* Sky

Diving out of an airplane is nothing to Buddy Bushmeyer, who is now regarded as the Greatest Dare-Devil of the Air.

By BUDDY BUSHMEYER

Here the rip cord has been pulled and the pilot 'chute can be seen wide open, high above Bushmeyer.

FOR seven years, I have been leaping into thin air and trusting to parachutes. I have landed in watermelon patches in Missouri, missed boulders on Colorado mountain sides, come whirling down at fifty miles an hour in a parachute spin. I have barely avoided high tension wires and once I came within what seemed an inch of dropping helpless out of the sky in front of a speeding train.

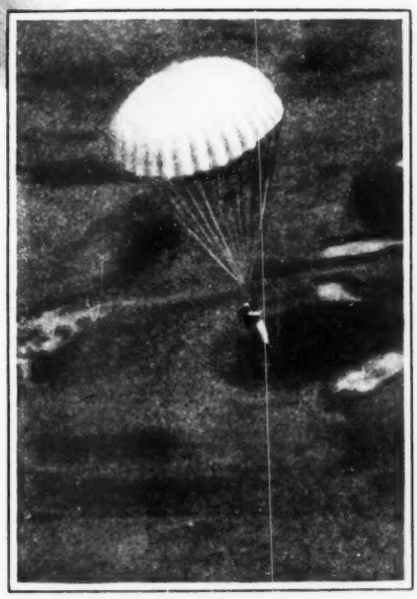
Yet, today, I am far less nervous about stepping off a plane, 3,000 feet in the air, than I am about looking down from the roof of a fifteen-story apartment building!

My first jump was made from a hot-air balloon at Excelsior Springs, Missouri. The professional jumper who had contracted for the exhibition had broken his ankle in a bad landing. I offered to take his place, climbed onto the trapeze, and away we went. When the balloon got as high as it would go, I pulled the knife that cut us loose. I sailed four miles and came down in the middle of a big watermelon patch. The farmer and his wife ran out and the farmer said:

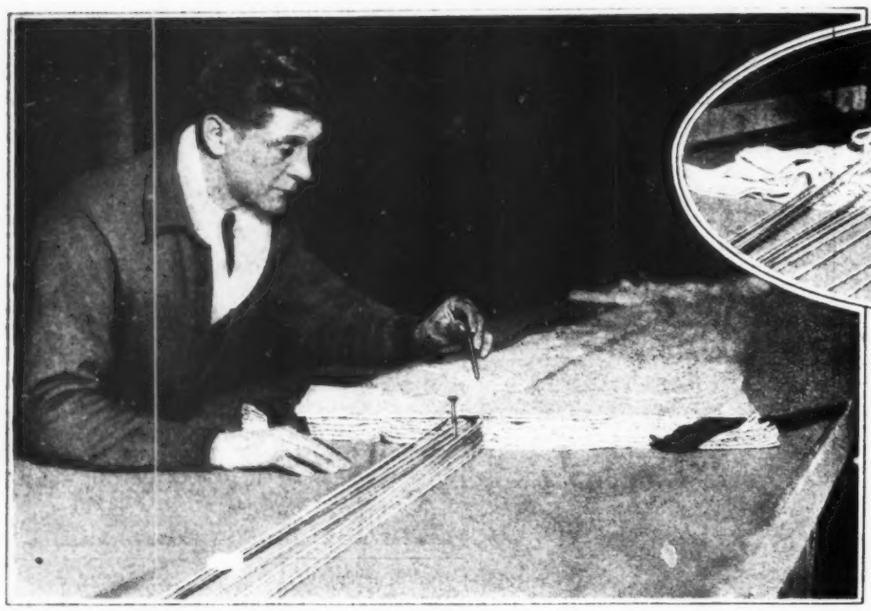
"By golly, I have had 'em come into my patch from all angles, but this is the first time anybody came in from the air." He gave me the biggest sweetheart melon in the patch. Just then, the reception committee, wearing high silk hats, drove up in a limousine. They had to sit on each other's laps on the way back to make room for the melon.

For airplanes, three types of parachutes are used: the seat-pack, back-pack, and chest-pack. The first is standard for pilots. The back-pack is an exhibition 'chute, and the chest-pack is usually employed with a back-pack when a double parachute drop is made.

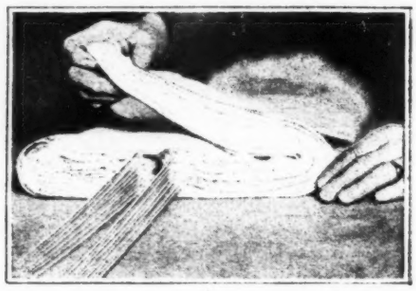
On any of these types, when the rip cord ring is pulled, the canvas case of the pack is snapped back by rubber cords and



The parachute on the job at last! Once more everything has worked as it should and the jumper is being lowered gently out of the sky.



The life of a flyer may depend upon the skill with which his parachute is packed. A peg driven into the bench upon which the packing is done prevents the lines from tangling as the folding progresses. The photo shows the first fold being carefully smoothed.

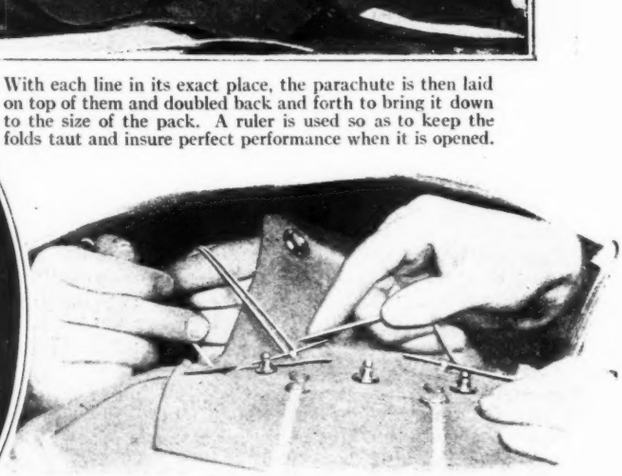


Half the folds are laid on one side of the lines and half on the other side. The parachute then assumes the shape of a flat Christmas tree. Sandbags hold the folds in place during this operation. Here Buddy Bushmeyer is seen folding his own parachute.

The third step is to lap the folds over toward the middle, thus making the final width the correct size to fit into the pack where it will be stowed for future use. Note that the lines are all still carefully separated from each other.

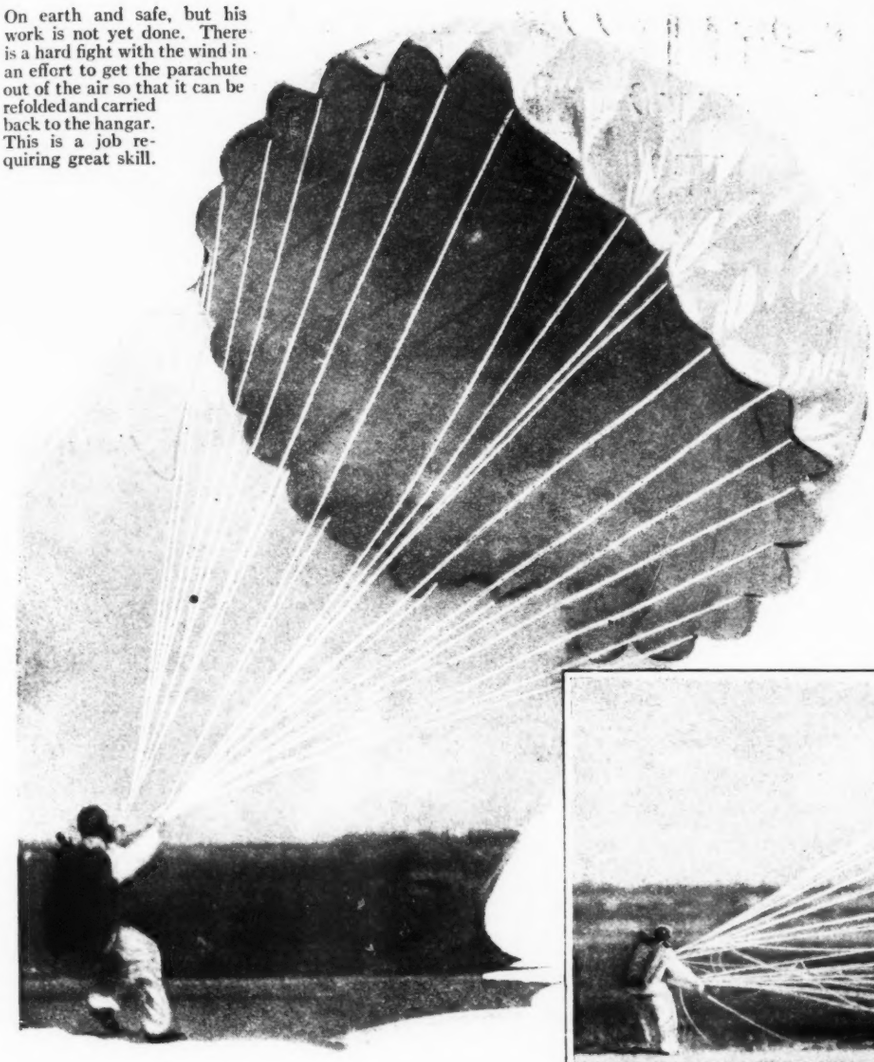
Inside the parachute pack, the lines are held in place by cloth loops, which makes it impossible for them to become tangled.

With each line in its exact place, the parachute is then laid on top of them and doubled back and forth to bring it down to the size of the pack. A ruler is used so as to keep the folds taut and insure perfect performance when it is opened.



The pilot parachute, left, is the last part to be packed. The release spring is oiled before the little 'chute is compressed and placed in the pack, so that it will be certain to leap out like a jack-in-the-box when the ring is pulled. Above, the last step of all in this vitally important operation of folding a parachute so that it will be sure to open. Here the rip cord pins are being put in place. When a rapidly falling flyer jerks the cord, these fly out, releasing the closely packed parachute which then bursts open, so that its fluttering folds catch the air and, billowing out, checks the swift descent.

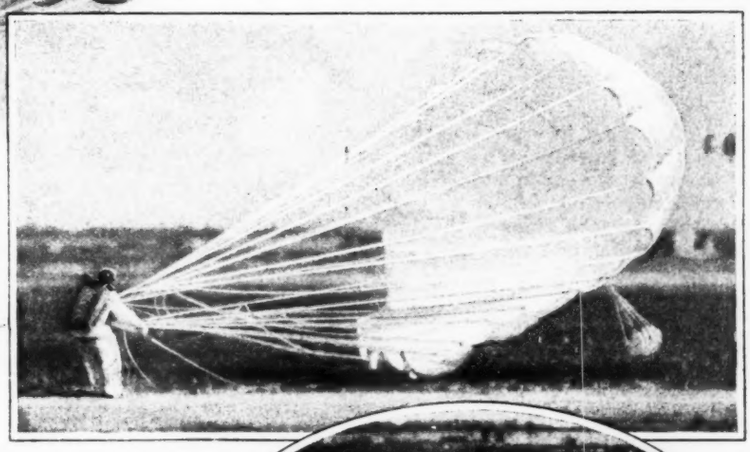
On earth and safe, but his work is not yet done. There is a hard fight with the wind in an effort to get the parachute out of the air so that it can be refolded and carried back to the hangar. This is a job requiring great skill.



had a chance to try an airplane jump and I have been at it ever since. I am now in charge of parachutes at Roosevelt Field, Long Island. Last summer, as head of the parachute school there, I trained fifty students in packing chutes and in jumping from the sky. There wasn't much excitement about balloon jumps. Your 'chute opened right away. The big punch in parachute jumping comes in the long free fall before you jerk the rip cord.

My longest drop of this kind was 2,000 feet, made last October at Roosevelt Field. I jumped at 8,000 feet and for nearly half a mile tore through the freezing air. When I pulled the ring, my feet were like chunks of wood and my hand was so numb from the cold that I could hardly grasp the ring. On the way down, I thawed out and made a good landing.

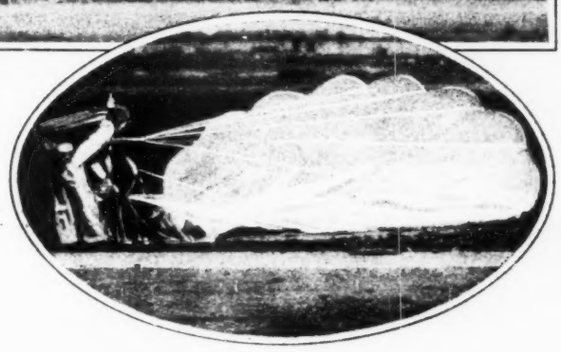
In a long plunge like that, the sensation is similar to riding ocean waves. You strike different currents of air that speed you up and slow you down. I keep my eyes fixed on the ground. It is important to know your position in relation to it in a free fall. If you are falling back downward with a back-pack, and pull the ring,



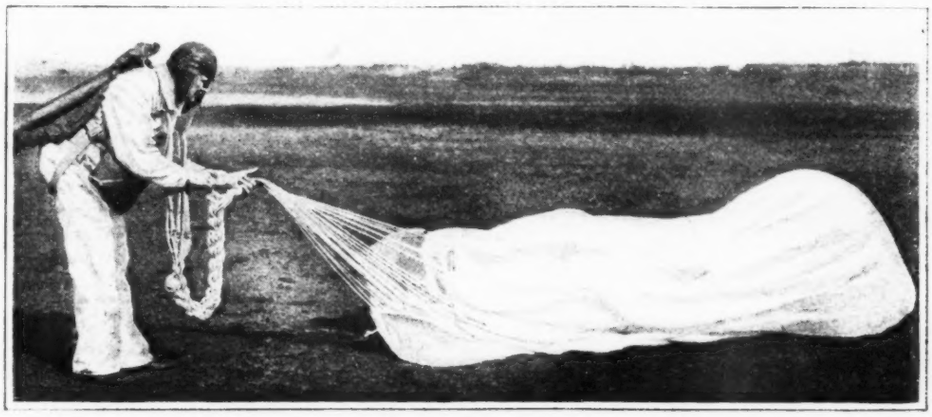
a small pilot parachute is shot out by a spring. This drags the main parachute out, decreasing the time required for it to open. About two seconds after the ring is pulled, the 'chute is completely open. Fully extended, the average chute measures from twenty-two to twenty-eight feet in diameter. One twenty-four feet wide weighs about eighteen pounds and costs $350. A few parachutes are made of linen, but most of them are of strong, light silk.

For three years, I followed the fairs, barnstorming with hot-air bags. Then I

The parachute is nearly subdued. Note the pilot which is already dragging on the ground. In this photo it is easy to see just how the air is emptied out of the 'chute by pulling the lower side along the ground until the folds are all lying flat and empty.



At right, the parachute is conquered. Remains now only to see that it does not escape before it is folded small enough to carry.



Now only the final folding is necessary to reduce the 'chute to the right size for handling. Note that Bushmeyer is braiding the lines carefully to keep them from becoming tangled when he picks the parachute up.

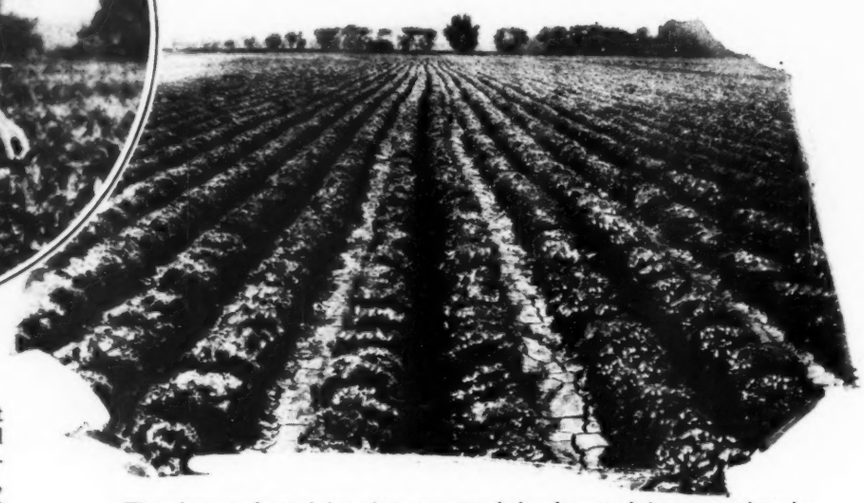
there is a chance that the 'chute may open under you and you will not be able to kick yourself free.

The longest free fall on record, I believe, was made by Jack Cope, over the Municipal Airport at Chicago. He got off at 15,000 feet and dropped 10,000 feet before he opened his 'chute. The jerk when a 'chute opens after a long fall is terrific. It comes mostly upon the shoulders. Sometimes after such a fall, my shoulders have been black and blue from the punishment the harness gave them. Modern 'chutes are designed to withstand the shock of a 200-pound load falling 400 miles an hour. Tests made at Wright Field, Dayton, Ohio, proved

(*Continued on page 119*)

"Plant Pill," Used in Big Fields, Gives Giant Yield to Farmers

Celery growing higher than a man's knees as the result of being fed on the new plant pill.



Three lettuce plants thrive where two grew before by use of the new condensed food. The heads are 75 percent bigger and fewer of the young plants die off.

FROM forty to seventy-five percent more sugar, both cane and beet, and from fifty to one hundred percent increase in lettuce, carrots, turnips, celery, and other vegetable crops, to the acre, are the results obtained by the application of chemical "plant pills" (P. S. M., Oct. '29, p. 29) to areas ranging from fifteen to forty acres. Dr. W. F. Gericke, chairman of the department of plant physiology of the University of California, and discoverer of the plant pill, has been working with market gardeners, beet-sugar farmers, and grain growers during the last year, and the value of his new system of plant feeding has been confirmed in actual agricultural operations.

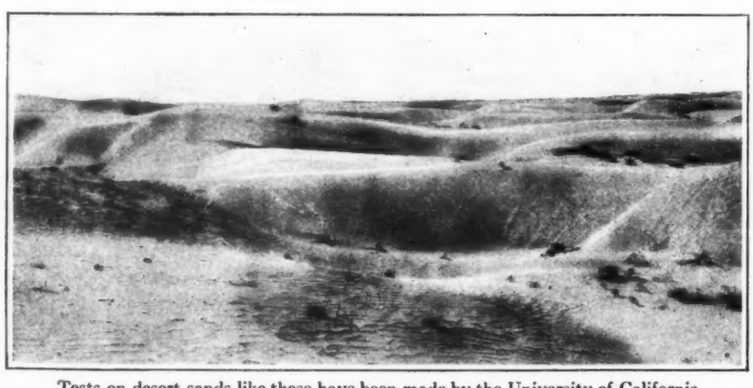
The new treatment to hasten plant growth involves the control of plant diet through the feeding of pills which contain, in right proportion, the things most needed by the growing plant. In each pill there are the seven elements of plant food, joined in varying amounts, to suit the plant being fed. Nitrogen, phosphorus, magnesia, iron, potassium, and sulphur are bottled up in little cylinders of a certain kind of plaster. The seventh element, calcium, is in the plaster itself. The pills may be put directly into the soil, but the best results seem to be obtained when the pills are dissolved in water and this solution fed to the plants. The soil thus treated has led in laboratory tests to almost unbelievable growth of plants.

A new method of quantity application of the plant pill to commercial crops also has been developed by Dr. Gericke and his assistants. Experiments have been made under conditions varying from sand deserts to fog-drenched and rain-flooded hillsides of the coast. Everywhere the results, when applied to plants and trees adapted to the area being tested, were the same.

Last October POPULAR SCIENCE MONTHLY published a report of the sensational results obtained by feeding to growing plants a food prepared by Dr. W. F. Gericke, of the University of California. At that time the food had been used only in the laboratory. Now tests have been made with it on the big fields of real farms which prove that the food helps grow amazing crops.

Desert sand-areas, on which nothing grew except greasewood, stunted mesquite, and an occasional cactus, produced all forms of commercial vegetables and melons with only the addition of the plant pill material and just enough water to act as a carrier. Dr. Gericke found that by raising ridges twelve to eighteen inches in height in the sand, he could create a hard floor by the manufacture of an artificial alkali on the bottom. This checked the seepage of the plant pill fluid through the sand. When this artificial alkaline hardpan had been thoroughly dried, it was covered with six inches of sand, the small plants or seeds put out, and the plant-pill solution added.

This method of making the soil form its own tankage eliminates the construction of the wooden or cement tanks at first used and described in POPULAR SCIENCE MONTHLY. Thus, the cost of preparing desert land for food production is reduced approximately fifty percent. The hardpan tank may be used a minimum of two years. Sizes fifty by one hundred feet were found most easily to form the bottom crust and hold the plant pill solution.



Tests on desert sands like these have been made by the University of California and, with the plant pill, garden truck equal to the best product of rich soil grown.

Under these condi-

(*Continued on page 131*)

Pinching the back of a sleeper's hand, as at right, made him dream of a black rat that came out of a hole, bit him, and then ran away.

While the subject was in an hypnotic sleep, various forms of stimuli were used to induce a dream. Pinching the hand with calipers brought strange dreams.

One subject dreamed, when his hand was rubbed with cotton, that a "brown cow with blue horns" came and licked the hand. Subjects are affected differently by the same stimuli.

Strange Dreams Made to Order

Experiments at University of Texas may solve mystery of visions in sleep

By DAVID BALLIN KLEIN

ABOUT a year ago we started some interesting experiments in the psychological laboratory at the University of Texas. We were working on the problem of finding an easy way of studying dreams. The solution to our problem came when we started to make the students, who had volunteered to serve as subjects in the experiments, indulge in hypnotic sleep. Once this kind of sleep was induced, dreams could be aroused without much trouble. For example, I told one of the subjects after he had been hypnotized that he was going to have a dream and then spoke the word "Help!" Presently the young man began talking:

"I had a dream. I was driving along the highway near my home. I heard yelling and we stopped. I went down and saw a car turned over on the side of the road. A man was crawling out. He said he wasn't hurt. He told me someone was under the car. I helped to turn it over. There was a woman badly hurt. We took her to the hospital."

"Could you see the car?" I asked.

"Yes," he replied, still asleep. "It was a brown car."

Then the young man was awakened, remembered his dream, and confirmed what he had already told us.

When we were sure of our method, we used it on other students who expressed a willingness to act as subjects. In this way we accumulated much information on many age-old questions. For example, may the ringing of an alarm clock cause a dream? What makes us dream of falling? Why do certain dreams recur time after time? How long does a dream last? Does a dream, such as the student's about an automobile accident, take place in less than a second, as some people believe, or does it last as long as the experience would require in real life, possibly half an hour?

HERETOFORE, questions such as the foregoing had given rise to more speculation than experimental study. The result was much contradiction and little established fact. Without a convenient way of producing dreams investigators were handicapped in an experimental study of the problem. Because of this, few such studies have been undertaken.

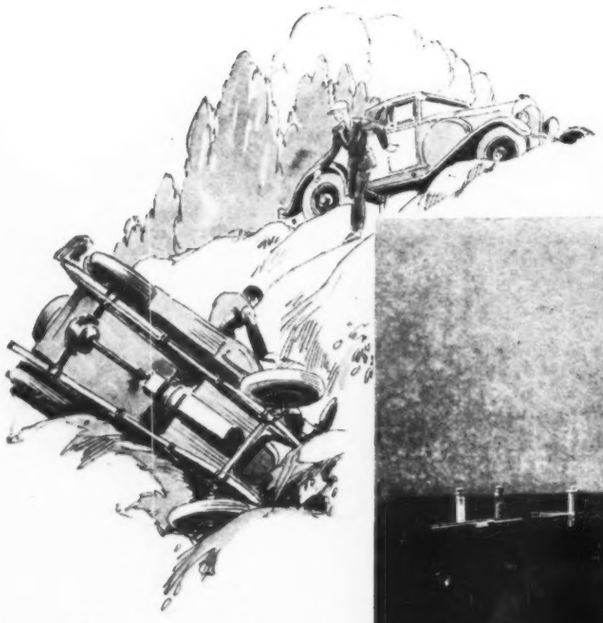
The chief merit of our recent work lies in the fact that it supplies this needed convenient method. In using it, we first induce hypnosis by means of suggestion. There is nothing particularly mysterious about the process. Our subject is placed in a comfortable chair and by means of the customary hypnotic technique made to relax his muscles and think of sleep. Before long he dozes off and at our request he places his head on his hands. After permitting him to sleep in this fashion for a few minutes, we ask him to sit up, the sleep state still continuing, and say to him: "I want you to watch very carefully for any dreams you may have, and as soon as the dream is over tell me all about it."

All that is then required to produce a dream is to stimulate the subject in some simple fashion such as pinching him, letting him smell some perfume, touching his hand with a cold object, or speaking a word like "Help!" or "Fire!" or any other word that is calculated to be significant for the subject. Before long the student starts to describe the dream. By means of a stop watch we are able to measure the length of time required for the completion of the dream. We start the watch when the subject is presented with the stimulus and stop it the instant he begins to tell about the dream he has just experienced.

USING this general method we have studied different problems connected with dreaming. Incidentally, it might be said that the dreams are all carefully

WHY do we dream? How long do our dreams last? Answers to questions such as these hitherto have been mere guesses; for, as long as the cause of dreams was unknown, no real study of them could be made. In this absorbing article a noted psychologist tells of the remarkable method he has developed of producing dreams at will, thereby revealing their cause, timing their duration, and pointing the way to a definite understanding of this fascinating subject.

THE EDITOR.



recorded by a stenographer as the subject describes them. In this way it is possible to analyze the material at leisure after the experiments have ended.

To indicate the variety of dreams secured by this technique, we may consider some of these stenographic reports. What the young man dreamt when we called "Help!" has already been told. The word "Fire!" in the case of another subject caused the following dream:

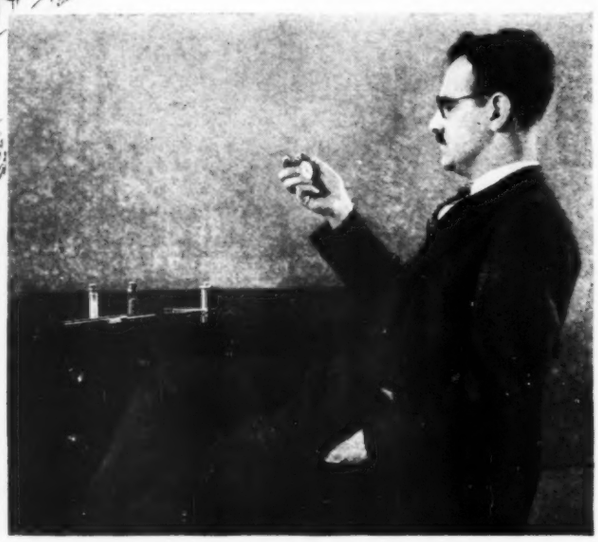
"I dreamed of a time when I was away from home. I had been out in the hills with a bunch of boys. When we came back, the home of one of the boys had been destroyed by fire. Burned completely down. The house was just a mass of charcoal. It happened the night before. Some of the timbers were still blazing just a little bit—they were still glowing."

"Did you actually see this fire?" I asked.

"No," the sleeper answered, "we didn't see this fire. It had already happened. We just saw what was left of the house."

Noises and tones are equally effective in stimulating dreams. A vibrating tuning fork, brought close to the ear of one of our subjects, made him dream of seeing and hearing a group of buzzing airplanes flying in battle formation. He was evidently re-experiencing events which were depicted in a sound film shown on the screen of a theater that he had visited some time before.

IN ANOTHER experiment, we ran a noisy electric motor connected with a piece of apparatus in such a way that a stick was made to strike projecting nails. This particular racket made one of our subjects dream, among other things, that he was in a blacksmith's shop. Here he picked up a horseshoe, ran toward some horses, and threw the horseshoe at one of the animals. The shoe, after hitting the horse, bounced back toward him and he caught it in his hands.



Dr. Klein times a dream. He found that only twenty seconds passed in a dream of an auto accident that the sleeper thought took half an hour.

Dreams such as those just described show what occurs when the stimulus is presented to the ear. Stimulating the sense of touch produced dreams just as readily. For example, during one laboratory period we pinched the back of the right hand of a sleeping sophomore three times with a pair of small calipers. At the end of his dream, the still dozing student said:

"A rat came out of a hole. He bit me."

IN the course of questioning him about this dream, we asked him to point to where he had been bitten. He pointed to the back of his right hand.

"What color was the rat?" I asked.

"Black."

"What did you do when it bit you?"

"I moved my hand, and then he went back in his hole."

ACTUALLY, the student had not moved his hand. He also reported that he had yelled, when as a matter of fact he made no outcry during his dream. In another experiment with this student, he reported a dream in which his hand had been licked "by a brown cow with blue horns." This rather bizarre dream was occasioned by stroking his hand with a piece of soft cotton.

In the course of another experiment, we found that the familiar dream of choking may be brought about by throwing a cloth over the sleeper's face and leaving it there momentarily. Bringing the skin surface into contact with cold objects may result in dreams centering around experiences with ice or snow. Once when a circular piece of metal was placed in the middle of one subject's forehead he dreamed "it snowed at night and the next morning" and that he made a snow man.

In one series of experiments, we studied the effect of stimulating the sense of smell. A bottle of perfume held under a sleeper's nose made him dream of his grandmother's garden and of picking flowers there. The odor of creosote caused him to experience the unpleasant dream of being on the operating table in a hospital with the anesthetist about to administer the ether.

A most interesting prob- (*Continued on page 124*)

Dr. Klein is proving here that dreams of falling, common to nearly everyone, can be caused by a slight depression of some part of the body, such as might occur when the sleeper moves.

A slight pressure on the side of the pillow made the sleeper dream he was falling head first and whirling.

NEW IDEAS AND INVENTIONS

On this and succeeding pages are described the latest achievements of inventors and novel applications of scientific progress

A complete section of track is laid at one time with this British machine which consists of a cantilever frame mounted on a railway truck. Worn-out rails and ties are lifted out in the same manner.

RAILROAD, TIES AND ALL, LAID BY NEW MACHINE

A WHOLE section of railroad track, ties and all, is lifted bodily from its bed and dumped on a car to be taken away. Then a new section is lowered into place. Thus a new British track-laying machine saves time and labor in replacing the worn-out part of a railway's trackage or in putting down new track.

Nothing exactly like this machine has appeared in this country, so far as is known. American railroads lay ties and rails separately, and one rail at a time. By doing a whole section at once, the British machine makes it possible for a few men to take the place of a much larger construction gang. A rugged cantilever frame, mounted on a railway truck, supports the powerful hoist that handles the track sections. An auxiliary to the tracklayer is a small car, about the size of a hand car, carrying a large motor-driven circular saw that trims ties to even width as it runs along the track.

Another part of the automatic track-laying machine. This truck runs along the newly laid track and with two powered circular saws, one on each side, trims the wooden ties to the required width.

GERMS USED TO IMPROVE SWISS CHEESE FLAVOR

MANUFACTURERS of Swiss cheese may soon be employing a remarkable new factory worker to flavor their product for them. His name is Streptococcus Thermophilus Orla-Jensen, and he is about three ten-thousandths of an inch in size. He is a heat-loving germ, and there are three members of his cheese-making family. "C-2," as he is called, is the most profitable individual of them all, since he is reputed to make cheese better in both its texture and flavor. Billions of his brothers would have to be used to make a single piece of cheese, but that would not be costly, as C-2 does not ask high wages.

The use of these bacteria in the production of cheese was recently reported by four experimenters of the United States Bureau of Dairy Industry. Not only do the germs influence the flavor of the cheese, the members of the Bureau said, but they may also be used to prevent the appearance of defects.

POPULAR SCIENCE MONTHLY is always pleased to answer questions on any subject within its field, if readers will address the Information Department, POPULAR SCIENCE MONTHLY, 381 Fourth Ave., New York, inclosing a stamped, self-addressed envelope for reply.

EXPERTS BAFFLED BY IODINE IN RAIN

IN KENTUCKY the inhabitants might be able to ward off goiter, the disease in which the thyroid gland in the neck enlarges, by drinking rain water. This is because of the mysterious presence in the rain of iodine, the chemical element which, taken in small amounts, prevents goiter, and which is known to most people as the brown liquid tincture that disinfects cuts. Dr. J. S. McHargue and Dr. W. R. Roy, of the Kentucky Agricultural Experiment Station, who recently reported the iodine discovery, said they do not know where the iodine came from.

Iodine, a peculiar brown solid in its

ordinary state, but which becomes a purple gas immediately upon heating, could not be found as a gas in the Kentucky atmosphere, the chemists said. Nor is it likely to come from ocean spray evaporated into the clouds, the usual source of iodine on the coast, because Kentucky is approximately five hundred miles from the sea.

How the much needed chemical manages to slip into the Kentucky rain seems to be an unanswerable problem. If it should ever stop doing so, however, Kentucky residents probably have nothing to worry about, since, according to these two chemists, there is apparently plenty of iodine in the forage crops and vegetables that are grown in the state.

MAY PRODUCE WOOL WITHOUT SHEEP

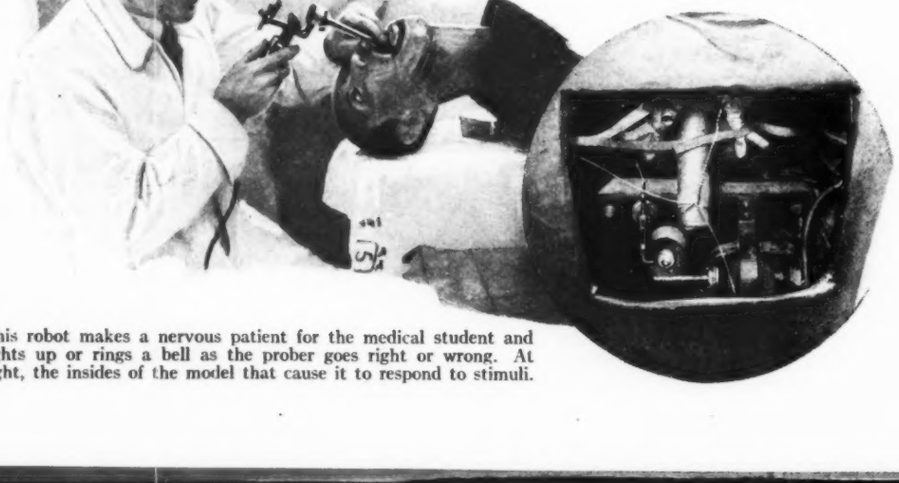
ARTIFICIAL sheep, capable of growing wool indefinitely, are predicted by the British Research Association for the Woolen and Worsted Industries. By merely slicing off pieces of live sheepskin and placing them in vats containing a certain chemical solution, the pieces may be continually nourished and thus should produce hair year in and year out.

This is the expressed belief of the association following recent experiments conducted by it on the hair growth of animals. There is no reason why cowhide could not be grown by such methods, the chemists of the association aver.

YOUNG DOCTORS' ROBOT RINGS BELL AT ERROR

MEDICAL students at Vienna, Austria, may now practice on a robot patient that flashes a light when they are right and rings a bell when they go wrong. Invented by Dr. Haslinger of that city, the mechanical patient is specially adapted for teaching surgery of the nose, throat, and esophagus (the tube connecting the mouth and stomach).

These parts of the body are faithfully reproduced in the model, which moreover breathes and has a heartbeat like a man.



This robot makes a nervous patient for the medical student and lights up or rings a bell as the prober goes right or wrong. At right, the insides of the model that cause it to respond to stimuli.

METER MEASURES MOVIE LIGHT

TAKING guesswork out of photography is accomplished by a new light meter for movie studios, designed to measure at any place in a room the intensity of the high power lights used. A needle swings across a numbered dial to record the intensity of illumination for the photographer's guidance; it is actuated by an electric eye built into the apparatus. Various intensities of light are assigned arbitrary numbers; the explosion near by of a small charge of flashlight powder, for instance, is registered by the device as light of intensity No. 12, or about one fourth of the maximum scale reading.

Light hits the photo-electric cell in this device and is gaged by current it sets up.

HELIUM NOW CHEAP GAS

HELIUM, the gas so desirable for inflating dirigibles and balloons because it will not take fire, can now be produced at one fifteenth its former cost. Change in process and quantity production cut the price. So announces the United States Bureau of Mines, which operates a government plant at Amarillo, Texas, at which helium is made at the cost of $9.64 per thousand cubic feet. This lowering of cost makes helium compare favorably with hydrogen in expense.

TINY FLASHLIGHT AID TO BEAUTY IN DISTRESS

POWDERING the face or applying rouge in the dark need no longer be a matter of dubious fumbling, in view of the recent appearance of a compact provided with a tiny flashlight. The lamp is said to give enough light to guide a girl in her use of cosmetics, in reading the program at the theater, or on the doorstep at home endeavoring to insert a latchkey.

NEW REFRIGERATOR GAS MAY COOL TROPIC HOMES

A NEW cooling gas for refrigerators may make the tropics a better place for white men to live. In northern homes, it offers an ideal refrigerant for household ice boxes of the mechanical or electric type, say engineers.

All such refrigerators now on the market use some gas that can be compressed and liquefied to abstract heat from the refrigerator chambers. Several of the gases that have been in current use are poisonous or at least irritating should they escape from the pipe coils that imprison them.

The new gas, described before the American Chemical Society, is nonpoisonous. Quantities of it, demonstrations show, may be breathed without the slightest ill effects. It is also noninflammable. These properties are the result of the peculiar chemical composition of the gas, which is a compound of three familiar elements—carbon, chlorine, and fluorine. Its technical name is "fluoro-chloro-methane."

Besides its household use, it may have other important applications because of its highly desirable engineering qualities. It may be used to cool sleeping rooms in the tropics, deep shafts in mines, and the cramped quarters of submarines.

FROZEN MEAT NOW SOLD IN CARTONS

FROZEN meat that comes in cakes is the latest addition to the housewife's larder The cakes are cut from fresh meat chilled by a refrigerating process to the hardness of ice. The meat retains its nutritive value, however, while the freezing (100 degrees below zero is the temperature to which it is subjected) protects it against invasion of germs.

A time in the near future when all meats will be distributed directly to the consumer from the packing plants in cartons containing the frozen cakes is foreseen by leaders of the meat industry. Thus meat joins the list of foods that can be preserved either by super-freezing or by putting up in handy tin cans.

POLAR REPORTS WANTED TO GUIDE WEATHER MAN

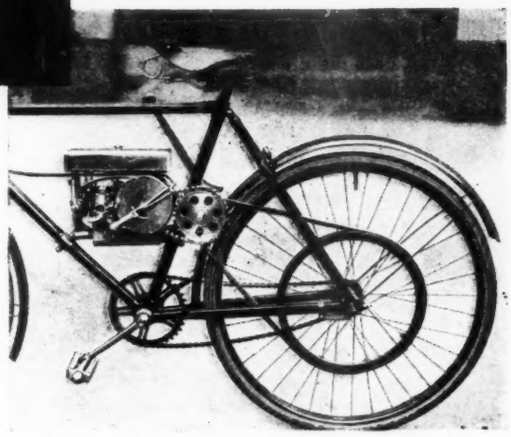
AUTOMATIC stations to broadcast weather reports from the polar regions are proposed by a European exploring society. Each station, containing about 3,000 pounds of equipment, would be transported to its permanent location by airplane. There it would transmit weather data three times a day, perhaps for a year without a "servicing" visit. Meteorologists would thus be provided with advance information of world weather.

The polar regions are believed to be the birthplace of much of the world's weather. For example, Dr. Isaiah Bowman, director of the American Geographical Society, recently said that spells of Antarctic weather seemed closely connected with rainfall and drought periods in Australia and Argentina. It would pay handsomely in crops and cattle and security of life, he declared, if weather stations were set up on the borders of the Antarctic. Recently Sir Hubert Wilkins, noted explorer, searched the Antarctic for suitable locations for such stations, to be established by international coöperation.

NEW SMALL MOTOR RUNS BICYCLE

BICYCLE enthusiasts may be glad to note the appearance of a new type of single-cylinder one-horsepower gasoline motor that attaches inside a bicycle's frame and weighs only eleven pounds. Recently introduced in Berlin, Germany, where it attracted considerable attention, it is fitted with a two-speed gear operated by a lever.

Hard pedaling on long roads is replaced with this motor by breezy sailing at automobile speed. It is air-cooled, economical as to gasoline, and is easily attached to the frame.



This air-cooled, two-speed, one-horsepower motor exhibited in Berlin can easily be attached to a bicycle.

TINY ELECTRIC BULLETS KILL FEROCIOUS GERMS

DISEASE germs may be killed in the future by tiny bullets from electric guns, instead of being poisoned by antiseptics as at present. In a study made at the University of Cincinnati, Dr. D. A. Wells was able to destroy numbers of the germ *Staphylococcus albus*, one of the most virulent germs known and the usual cause of boils, by bombarding them with electronic bullets in a vacuum tube. An electric pressure of only thirty volts was needed to produce the effect. A battery of twenty dry cells could give this current. When the electric voltage was raised, the additional energy substantially increased the slaughter of the germs.

BACTERIA BLAMED FOR STRANGE FARM FIRES

BESIDES being blamed for the spread of disease, germs may soon be convicted of arson. Disastrous farm fires that start by so-called "spontaneous combustion," meaning that they start themselves, may be caused by the action of microbes. This is the belief of the United States Department of Agriculture, which is investigating the subject. It has set up an experimental farm at Beltsville, Md., where the conditions under which such fires take place may be reproduced as exactly as possible.

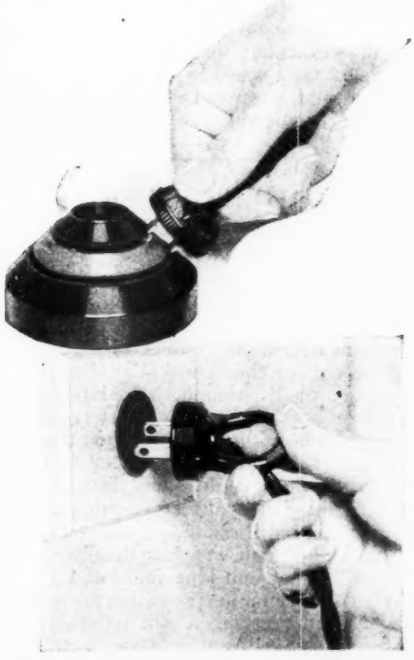
Fires occur in hay, grain, feeds, fertilizers, and farm manures with no known cause. It may be that bacteria, always to be found in abundance on such products, generate heat even up to 160 degrees Fahrenheit, within their own bodies. The chemical action which they thus have begun may actually start a fire. At the Government's experimental farm work is being done with quantities of alfalfa hay in an attempt to verify this theory.

Such fires cause millions of dollars loss every year, says Dr. W. W. Skinner, of the Bureau of Chemistry and Soils.

BLIND MAN CAN WORK THIS ELECTRIC PLUG

Two devices recently designed facilitate attaching an electric plug and eliminate dangers from wear and tear on wire insulation. The first is a cone shaped electrical connection, with two adjacent grooves running around the cone, one groove for each of the two prongs of an ordinary plug. Pushing in the plug at any point in the groove makes the contact for current to operate various electrical table appliances. A blind man could work this connection piece, as no particular opening need be found.

The second device is itself a plug, made with a ring at the base for the finger to grasp in removing or inserting the plug. It is said to lessen the likelihood of broken finger nails and other annoyances resulting from attempts to get a firm hold on the customary plain-topped connection plug, and eliminates, also, wire breakage caused by pulling on the cord in efforts to loosen the plug from the wall slot.



Above, grooved cone-shaped receptacle, showing how electric plug is attached. Below it, plug with ring to be grasped in pulling it loose.

Above, George Barton French, of New York City, and his invention for the deaf; below, adapted to allow aviator to hear through neck.

APPARATUS MAKES DEAF HEAR THROUGH NECK

AVIATORS and deaf persons hear through the neck instead of through the ear—with a new aid to hearing invented by George Barton French, former railroad executive and socially prominent in New York City.

With this device, pilot and passenger can converse freely above the roar of an airplane motor. A band holds the receiver snugly against the neck, and its sounds are audible in spite of external noise. Other models of the invention, adapted to the use of persons hard of hearing, include one like a camera case, to be slipped in the pocket, and another that is carried in a small inconspicuous eyeglass case.

NINE-MILE GUN SHOOTS 800 TIMES A MINUTE

A TRAVELING salesman turned inventor to design a machine gun of nine-mile range, said to be one of the deadliest of weapons ever built.

Too old for the World War, Robert F. Hudson, of Richmond, Va., labored at home on a machine gun. The war ended, his weapon unfinished. He persevered. The other day he demonstrated to navy officials that it could shoot fifty caliber bullets nine miles, at a 800-a-minute rate. They accepted the gun.

It can be made in other deadly types. One will shoot foot-long shells of 1.1 inch caliber thirteen miles; sensitive projectiles explode on piercing a silk handkerchief 300 feet away. Another type fires 1,400 thirty-caliber bullets at aircraft, faster than any other gun made.

ITALY NOW IN RACE FOR WORLD'S FINEST SHIP

SEVERAL nations are entering the keen competition to produce the world's finest ocean vessel. Italy is the latest contestant. She has begun construction on the *Rex*, a palatial floating hotel that is to have a theater, church, garage, and two swimming pools.

The new ship should be able to hold her own in the rivalry for fast ocean crossings, as her engineers are expecting her steam turbine engines to develop 90,000 horsepower, with a resulting speed of twenty-seven knots. The liner will be 887 feet long, ninety-seven feet wide, and will weigh 45,000 tons.

Ten decks will compose her superstructure, six of which are to run the entire length of the ship. She will have a double bottom, and will be divided into fourteen water-tight compartments. These will keep her afloat even when three adjoining compartments are flooded.

The builders of the new vessel, which is being constructed for an Italian line, intend to install a wireless telephone in every cabin.

YOUR AGE DEPENDS ON COLDS YOU'VE HAD

A PERSON is as old as the number of colds he has had, according to a recent statement made by Dr. E. J. Abbott, of the New York City Health Department, who emphasized the seriousness of these so-called mild afflictions. Every cold leaves behind it an imprint on the individual's physical system, the doctor said, and as these so-called "common colds" pile up through the years they may lead to grave consequences.

Simple rules were laid down by Dr. Abbott to help guard against colds. First, stay away from persons with colds, especially in closed places. In the winter people tend to flock together indoors, and thus pass germs to each other. Secondly, breathe through the nose. And lastly, sleep with the window wide open.

Machine gun, accepted by the Navy, demonstrates its remarkable ability to fire eight hundred bullets a minute and hit the objective on a nine mile range.

SECRET LIQUID BATHES HIGH VOLTAGE SWITCH

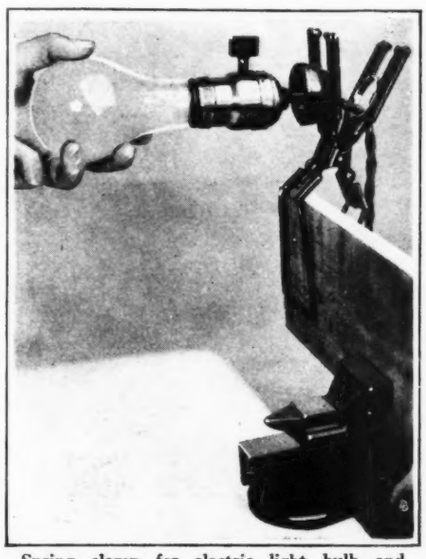
A NEW type of switch for controlling currents up to 600,000 volts, invented in Germany, is said to prevent dangerous sparks when the switch cuts off the current. Switches now in use for high voltages are cumbersome giants immersed in a tank of insulating oil to prevent the flashes. The charred oil must be changed often. The new switch, produced by the German electrical works of Siemens-Schukert, is bathed in a liquid the formula of which is still a secret, but which is understood to be far superior to oil as an insulator.

Another switch which also may ultimately replace the bulky power switches of the present is one encased in a vacuum chamber of glass (P.S.M., Apr. '30, p. 31). It was developed by Dr. R. A. Millikan and Professor R. W. Sorenson of the California Institute of Technology, located at Pasadena, to control the millions of volts that are used there in electrical tests. A vacuum so nearly perfect that it contains less than 1/760,000 as much air as an equal space of the outside atmosphere minimizes the flash of the arc when the switch breaks the electrical circuit.

SPRING CLAMP ON LIGHT FASTENS ANYWHERE

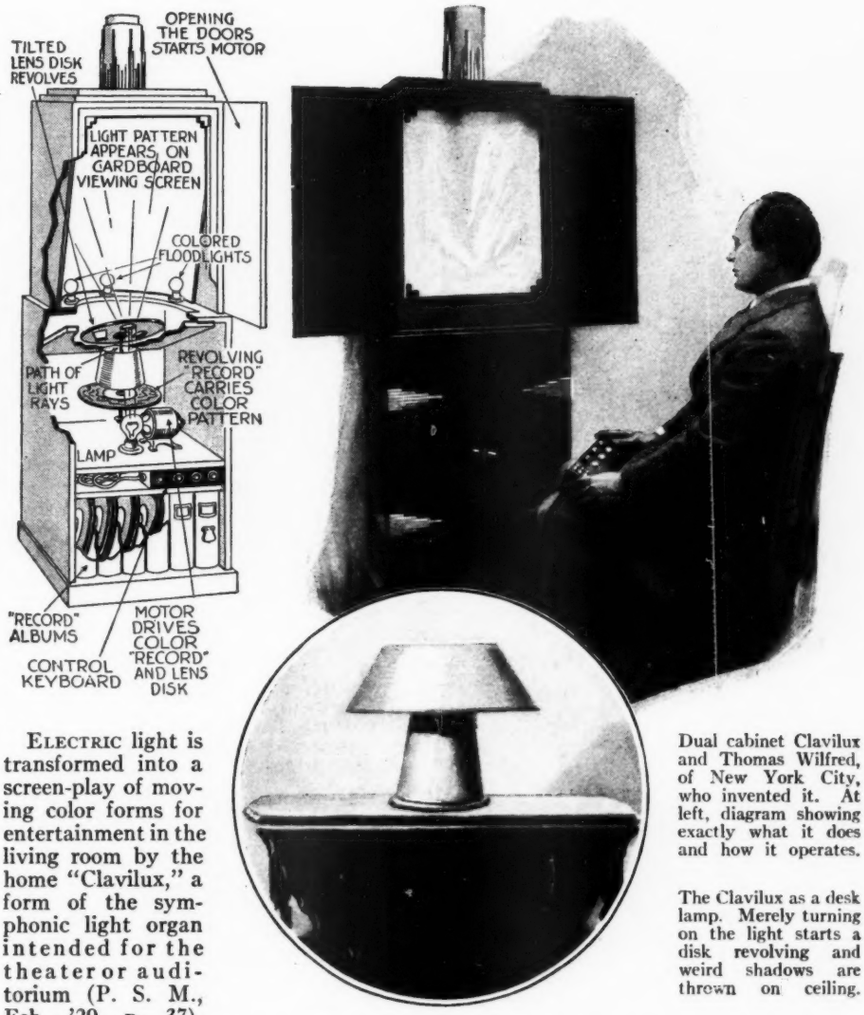
HEAVY wire clamps that can take hold of any shaped object of any thickness up to three inches are the mainstay of a new device that converts an ordinary electric light bulb and socket into a portable lamp for use at the bedside or in other parts of the room.

The outfit can be fastened to any projecting surface; the spring jaws adjust themselves automatically to diverse forms and thicknesses and do not mar the surface. The novel lamp is a convenient companion, since no bolts, nuts, screws, or tools are required for its use. It is said to be as handy to carry about and set in place as the candlestick of former days, and it is certainly less dangerous from the standpoint of fire risk.



Spring clamp for electric light bulb and socket makes a convenient portable lamp.

MACHINE MIMICS GLOW OF FIREPLACE



Dual cabinet Clavilux and Thomas Wilfred, of New York City, who invented it. At left, diagram showing exactly what it does and how it operates.

The Clavilux as a desk lamp. Merely turning on the light starts a disk revolving and weird shadows are thrown on ceiling.

ELECTRIC light is transformed into a screen-play of moving color forms for entertainment in the living room by the home "Clavilux," a form of the symphonic light organ intended for the theater or auditorium (P. S. M., Feb. '29, p. 37). The new instrument, adapted to the home, is designed as a dual cabinet in the modernistic style, the upper section containing a screen upon which color symphonies are played from a projection apparatus in the cabinet below.

The way in which the projection mechanism works is similar to that of a phonograph, the operation depending on a small electric motor that revolves a turntable bearing colored glass disk records about the size of ordinary phonograph records. At this point the resemblance ceases. Instead of producing music, the glass disk record of the Clavilux breaks up light coming from just beneath it into whirling color patterns that are focused by lenses on the cardboard screen above. A great variation of the patterns on the glass disks is possible, with color harmonies to suit every mood.

The performance is controlled from a small keyboard box that may be removed and taken to any part of the room. Weighing only a few ounces, the keyboard has buttons for controlling light intensity, color modification, and changes of focus by means of the lenses. Step-down transformers, connected with the regular light circuit, provide the necessary current. The motor starts automatically as the cabinet door opens.

Another variety of the same instrument is one designed to look like a moderate sized desk lamp. It plays the same records, but uses the ceiling as a screen. The effects obtained with either of these light consoles are intended, the inventor claims, to give to a room in a modern home the pleasing glow which in former times was furnished by a fireplace.

WOMAN BREATHES ONLY THREE TIMES A MINUTE

A WOMAN who breathes only three to five times per minute has been discovered by Dr. Francis G. Benedict, of Boston. Her breathing rate is approximately one sixth that of the normal individual, who inhales and exhales about eighteen times a minute. Dr. Benedict went, all over Europe lecturing on her breathing process and searching for other examples of it. He was unable to find any similar cases, he reported upon his return.

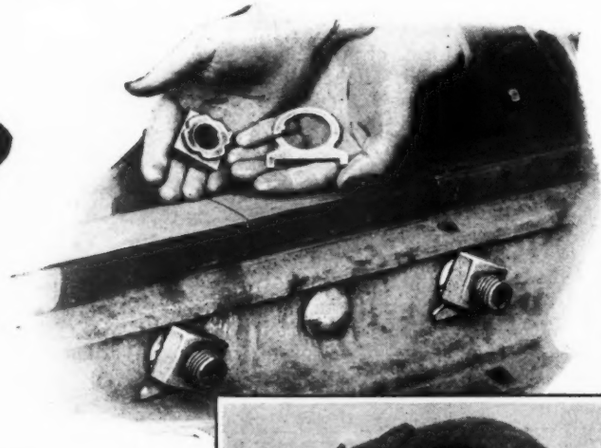
The woman's lung capacity, however, is normal. But, instead of inhaling one pint at a time, as the ordinary person does, she inhales three pints, thus giving her the same amount of air per minute that normal persons breathe. Whether the quirk in her breathing is due to the action of the nerve center which controls breathing, or to some other irregularity, the doctor has not determined.

Mechanical Aids for Play or Work

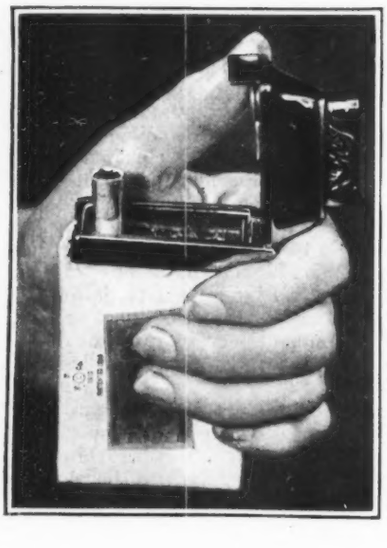
TEACHES YOU TO DANCE—A Berlin dancing master invented this checkerboard affair to make it easy to learn dancing steps. It is a floorboard, designed to fit the average size room. On it are numbered squares. A code tells upon what square the feet should be for each step.

A TINY PROJECTOR—This movie projection machine, invented in Germany, is less than four inches long—small enough to fit in a coat pocket. A special size film is used. The battery is so powerful that 200 shows can be given without changing it. The image that is thrown on a screen or wall by the tiny device is about the size of a picture frame.

SOMETHING NEW IN PIPES—The stem is curved to fit the chin, against which the pipe rests. The idea is to save the teeth by making a tight grip unnecessary.



NEW NUT-LOCK—Vibration which is caused by the passing of heavy trains will not loosen this rail-joint nut-lock, says the inventor. Note the notches in the shoulder of the nut. These catch in the tooth of the washer and keep the nut from slipping. The Union Pacific Railroad is experimenting with this new device.



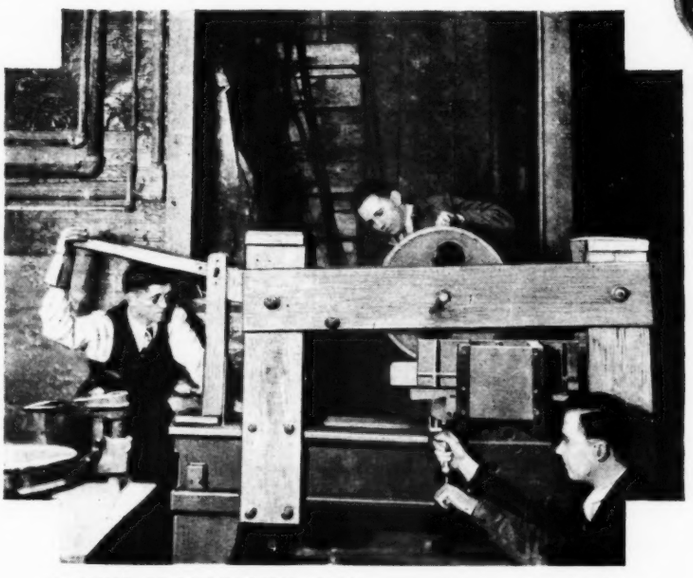
LIGHTER ALWAYS HANDY—When you reach for a cigarette, you can't miss this lighter, as it fits on top of the package. The metal frame to which it is attached slips inside any standard size package and thus becomes a sort of skeleton case that keeps your cigarettes from being crushed.

NEW USE FOR A HAT—By this invention a woman's hat is made into a sort of overnight traveling bag. A pocket containing a latchkey, powder puff, and needle and thread fits into the side of the hat. When the flap is closed it is effectively hidden. Makers of men's hats might follow suit; quite a lot could be easily hidden away in a silk top hat.

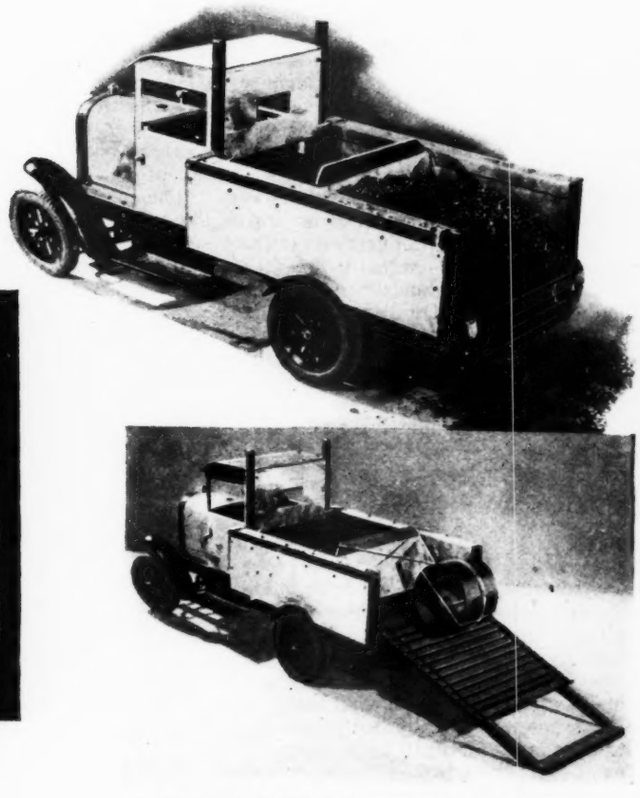
A BOOK FOR YOUR LUNCH—Those who carry their lunch to work or on pleasure trips will find this new lunch box convenient and appealing. When closed it looks exactly like a fair sized book of reference, yet it is large enough to hold all that one would care to eat at a meal.

NO CABLES IN THIS ELEVATOR—Model of a lift, the work of a Washington, D. C., engineer, which operates much on the principle of the extension arm of a desk telephone. The cage is operated by "lazy tongs" run by machinery.

A LIGHTER FOR PIPES—There is nothing new about electric lighters for cigarette or cigar but this one is so designed that it can be used to light pipes, as the end is the right size to fit the pipe bowl.



MAKING GREAT BRICKS—Bricks twenty feet long and five feet wide may be made by a new process developed at State College, Pa. The photo shows Professor Joseph B. Shaw, left, H. C. Beard, center, and Myril C. Shaw at work in the State College laboratory. In the photo a white-hot brick is being compressed as a demonstration of their method, which may revolutionize the brickmaking industry.



SLIDING FLOOR FOR TRUCKS—No elevating of the front end is necessary with this new English truck which has a sliding floor, electrically operated. The lower view shows the floor as used to load heavy objects. The upper picture shows the truck being unloaded, the moving floor dumping the coal.

CAR TRUNK SUITS SHOPPER OR TOURIST

A NEW carrier for automobiles that holds as much as a large chest when closed and is as wide as the car when opened, will hold an unusual amount of heavy traveling luggage. It has compartments on each side which swing outward on pivot rods to form, with the center piece, a wide, balcony-shaped container which has enough room to accommodate two good sized trunks and several suitcases.

Another feature is the lock mechanism, which works as simply as that of a traveling bag. When shut like a chest, the carrier can be used by the shopper, as it makes a handy place for small parcels.

Above, the extension luggage carrier as it appears when used in shopping. Diagram at right shows how it opens to take in trunks and traveling bags.

FINDS GERMS SHRINK SO THEY CAN'T BE SEEN

MICROBES, the animals too small to be seen, which lead such widely divergent careers as producers of disease and curdlers of milk, are becoming more difficult to analyze than ever, according to Dr. Philip Hadley, of the University of Michigan Medical School. At best the ordinary microbe or germ is so small that, even when fully grown, a thousand of them can gambol on the head of a pin without getting in each other's way. Dr. Hadley, however, tells of finding evidence that germs pass through stages in their life history in which they are too small to be recognized through even the strongest microscope. He was able to make germs change into forms so minute that they were invisible and could squeeze through the pores of a porcelain filter candle. After certain treatments in the laboratory, these tiny bodies would grow back to their normal shape again.

The meaning for the medical world of these discoveries may be of great importance, authorities say. While germs are moving about disguised as individuals only half their normal size, too small to be caught under the microscope, there would be no way under the present methods of medical detection of recognizing them in infected tissues and body fluids. Also there would be no way of knowing whether germs were "playing 'possum" or were really dead. Such uncertainties would make the accurate diagnosis of a disease extremely difficult.

POWDER, LEFT FROM WAR, LACQUERS YOUR CAR

FEW PEOPLE know that the lacquer which gleams on the bodies of thousands of automobiles today may have once been on the point of hurtling a shell many miles into space or blowing up a trench.

The conversion of millions of pounds of powder left over from the war into industrial finishing products was the unusual story told recently to the American Chemical Society by R. G. Woodbridge, of the Du Pont company. The new cellulose lacquers, he said, bear so close a relation, chemically, to the nitrocellulose base of smokeless powder that changing the war product into a peace product is comparatively easy.

AUSTRALIAN LAKE LOOKS LIKE LAKE BUT ISN'T

AN IMMENSE salt lake has been found in the desert of central Australia by Cecil Madigan, Australian explorer.

Lake Eyre is a lake in everything except water. It has steep shores rising at times as high as thirty feet, with what look like ice floes but which really are patches of salt. The lake, Madigan estimates, contains at least three billion tons of salt in the northern part alone.

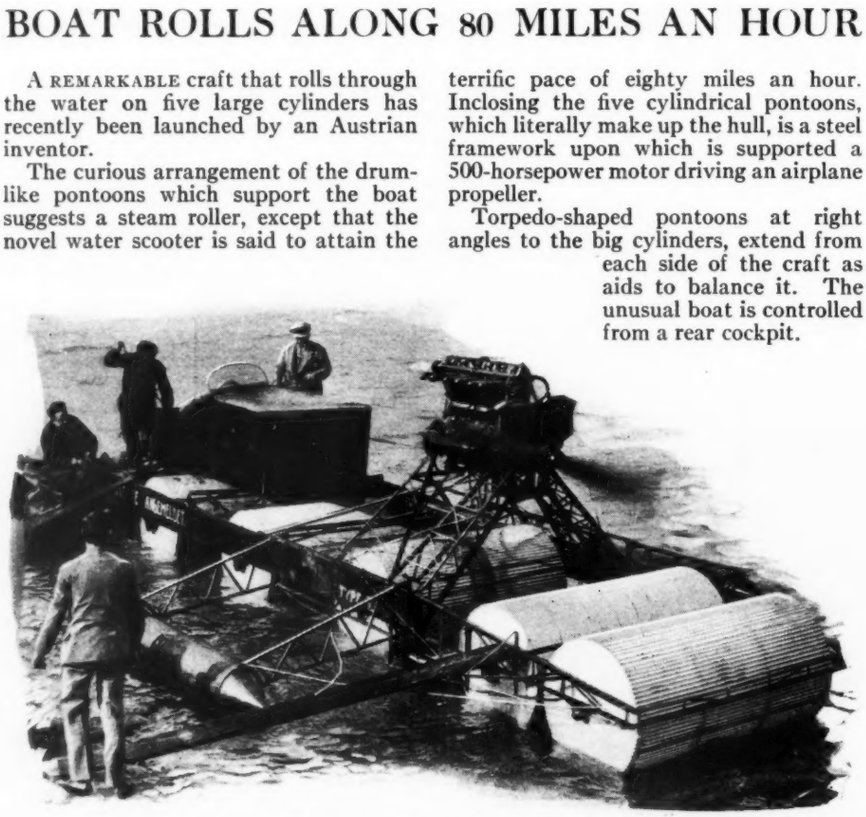
The Australian explorer drove for miles on the lake's surface, finding three-inch lizards twelve miles from the shore. These lizards apparently have nothing to live on except large colonies of ants.

BOAT ROLLS ALONG 80 MILES AN HOUR

A REMARKABLE craft that rolls through the water on five large cylinders has recently been launched by an Austrian inventor.

The curious arrangement of the drum-like pontoons which support the boat suggests a steam roller, except that the novel water scooter is said to attain the terrific pace of eighty miles an hour. Inclosing the five cylindrical pontoons, which literally make up the hull, is a steel framework upon which is supported a 500-horsepower motor driving an airplane propeller.

Torpedo-shaped pontoons at right angles to the big cylinders, extend from each side of the craft as aids to balance it. The unusual boat is controlled from a rear cockpit.



Five cylinders support this boat, which was invented and launched in Austria. It has an airplane propeller that is driven by a 500-horsepower motor resting on an open steel frame supported by the cylinders. Torpedolike tubes on either side steady and balance the craft. The control cockpit is at the rear of the strange watercraft.

TANBARK PADDING MAKES FOOTBALL FIELD SAFE

IN ADDITION to padding the shoulders of football players, why not pad the gridirons? The practical possibilities of this question for safer football are being investigated at the University of Illinois. Adopting a method which has been used for some time for padding circus rings, the department of agriculture of the university has covered the gridiron with a blanket of tanbark, crushed pieces of the bark that is used in the tanning of leather. The natural springiness of this material already has proved it an effective preventive of injury from heavy falls.

Its great disadvantage, however, is that its surface is too much like a cushion to permit fast running. The authorities conducting the experiment are hoping, nevertheless, that constant pounding of the tanbark by the feet of players will after a few games so pack it down that it will afford a good grip for the cleats of football shoes.

If the experiment with this new covering is successful, it should prove to be a vast improvement over the ordinary turf field, which readily turns into a lake of slippery mud in wet weather.

WITH MOTOR ON BACK HARD JOBS ARE EASY

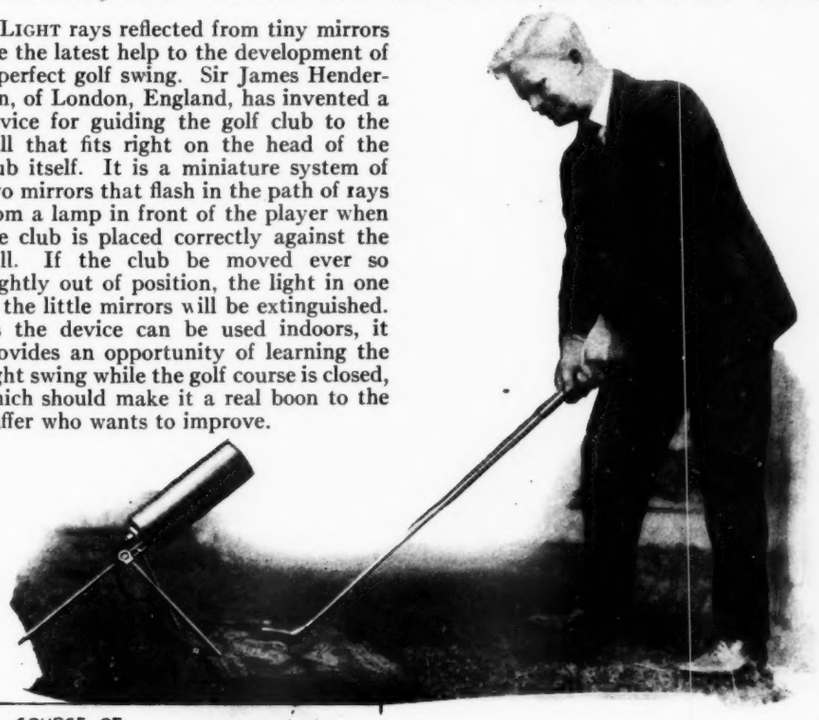
THIS gasoline motor strapped to your back will, according to its inventor, do any number of irksome tasks for you. Operating a wide variety of tools adaptable to motor power such as saws, drills, or garden apparatus is in its line. It is shown below operating a hedge-clipper.

The portable power outfit recently was demonstrated in Leipzig, Germany. It is supported by a tubular frame with short legs attached to support it when placed on the ground. Springs holding the motor to the frame at several points help to lessen the effect of the vibration against the user's back when the machine is running. The motor has two cylinders and is air-cooled. A muffler deadens the sound of the exhaust. The supply of gasoline is in a tank at the head of the frame.

Inventor proves the value of a light motor that is carried on the back to do heavy work.

MIRRORS THAT GUIDE GOLFER'S SWING

LIGHT rays reflected from tiny mirrors are the latest help to the development of a perfect golf swing. Sir James Henderson, of London, England, has invented a device for guiding the golf club to the ball that fits right on the head of the club itself. It is a miniature system of two mirrors that flash in the path of rays from a lamp in front of the player when the club is placed correctly against the ball. If the club be moved ever so slightly out of position, the light in one of the little mirrors will be extinguished. As the device can be used indoors, it provides an opportunity of learning the right swing while the golf course is closed, which should make it a real boon to the duffer who wants to improve.



Sir James Henderson, of London, demonstrates device to help golfers learn to drive.

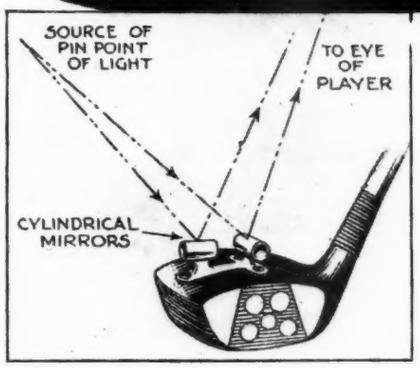


Diagram showing the position of the mirrors on head of golf club and how light hits golfer's eye.

MIND MUST BE WORKED TO KEEP IT KEEN

EXERCISE your mind if you wish to always keep it in perfect tone is the advice of Herbert Sorensen, of the University of Minnesota. Lecturing recently before the American Association for the Advancement of Science, he stressed the importance of never stopping the learning process. To grapple with new problems, languages, or scientific theories is just as important to the mind, he says, as training is to the athlete. To prove his statement, Sorensen said that the older students at the university who resumed study after a long period of neglect showed a loss of capacity to learn

LOW VOLTAGE CURRENT MAY CAUSE DEATH

"DANGER—Low Voltage."

Such a sign over an electric wire would surprise many persons who are accustomed to think only of high voltage, or electrical pressure, as dangerous. Yet sometimes low voltage wires may be more deadly than others, Professor W. B. Kouwenhoven, electrical engineer, and Professor O. R. Langworthy, neurologist, both of Johns Hopkins University, recently reported.

This is true, they say, of alternating current, the kind of electricity supplied to most homes for electric light, which differs from "direct current" in that it flows forward and backward many times a second. Direct current, supplied by dry cells and storage batteries, and by dynamos in some power stations, flows only in one direction.

When a person gets a shock from a high voltage alternating current wire, these experts declare, it usually contracts his muscles so violently as to throw him away from the wire. If, however, he is unfortunate enough to seize a low-voltage alternating current wire by accident, it sometimes is impossible to let go. One fiftieth of the current used by the average household lamp, passing through the body, is extremely painful; more than a tenth of the current the lamp uses is likely to be fatal. Common 110-volt house lighting wires are dangerous to touch if the skin is wet, since the moisture makes possible a good contact which allows the current to flow readily into the body.

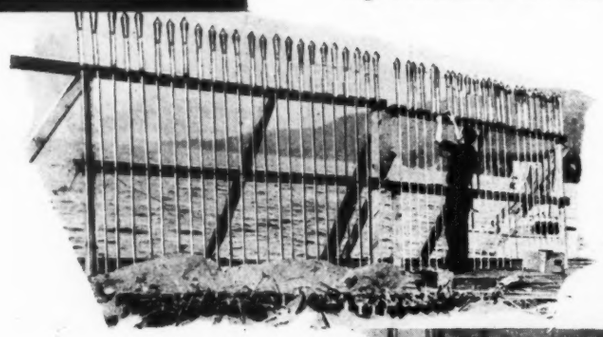
Direct current wires are less perilous, according to the investigators.

The pride of all fireworks makers. A display of rockets and bombs on Lake George, in New York.

Why Your Fireworks Flash *and* Go BOOM

Mystery of crackers and rockets explained. How inventors work to produce new noises and color effects.

By ALDEN P. ARMAGNAC



This battery of skyrockets was part of the display pictured above. The head of the rocket holds the colored balls that burst out at the end of the flight and shine so brilliantly against the inky blackness of the night sky.

"REPEATING Bombshells. Exhibiting the most brilliant, marvelous and bewildering effects ever produced in pyrotechny . . . Rockets. Bursting in midheaven, they form an aurora borealis-like shower of electric jewels of emerald and sapphire tints, falling slowly to earth. . . "

These glowing phrases picked at random from the latest fireworks catalogue announce the approach of the Fourth of July as surely as a seed catalogue does the spring. In preparation, makers of fireworks are busy cramming balls of fire and showers of sparks into pasteboard tubes with gayly colored labels. At stores and roadside stands throughout the country, local ordinances permitting, they will be sold to millions of small boys and grown-up boys who will "oh" and "ah" as they go off.

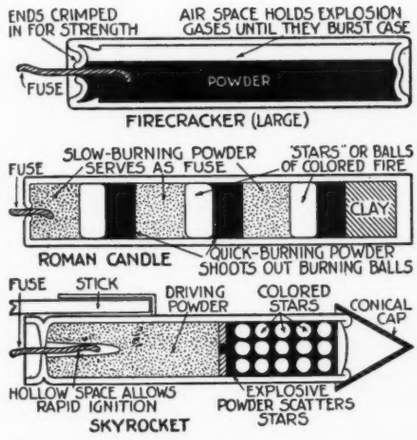
How do they work? Recently I visited the Staten Island, N. Y., plant of the largest manufacturer of fireworks in the country—an eighty-nine-acre field, dotted with some two hundred frame buildings, many of them just large enough for one man to work in. They are of light frame construction, so that in case of an explosion nothing heavy will be hurled through the air. They are spaced far apart, so that flames cannot spread.

It is in these tiny buildings that the men perform the more dangerous operations—filling the cases of rockets with compressed powder, making the "stars" or colored balls for Roman candles. "When the wind is high, we shut down the whole plant," the superintendent, Clark B. Allen, told me. Just a safety precaution, in case of fire!

At one end of the plant is a "proving ground" where fireworks are tested. There is a laboratory where new powder mixtures are tried out, under hoods that suck away the acrid smoke. Also a "dark room," where the effect of night fireworks is observed in a chamber from which daylight is excluded. Here is where the fate of many a new invention in fireworks is decided, for makers are searching endlessly for novelties.

It is no easy task, after twenty-three centuries of fireworks-making. The history of the art goes back at least that far. Although the Chinese are generally supposed to be the inventors, records show that as early as 429 B.C. the Spartans tried to burn down the besieged Grecian city of Plataea with fireworks, in which, of course, there was no gunpowder.

Pinwheels for the glorious Fourth. This girl in the Staten Island, N. Y., fireworks factory is shown attaching fuses. You can easily imagine what a stray spark would do here.



Diagram, revealing the interior of firecrackers, Roman candles, and rockets, shows how they work.

Today, anyone from salesman to superintendent may have a new idea that works. This year's new fireworks, for example, include the "Midnight Sun," a variety of pinwheel.

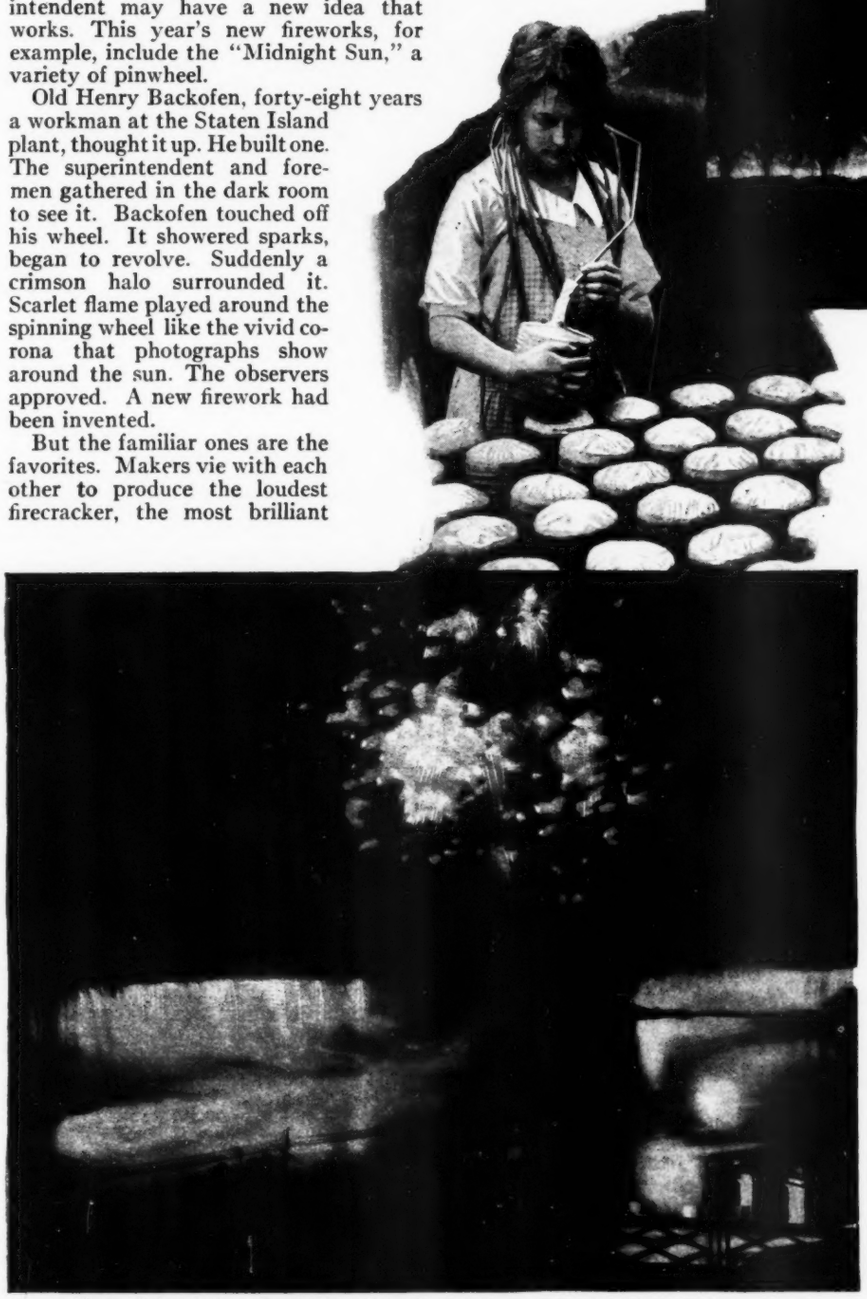
Old Henry Backofen, forty-eight years a workman at the Staten Island plant, thought it up. He built one. The superintendent and foremen gathered in the dark room to see it. Backofen touched off his wheel. It showered sparks, began to revolve. Suddenly a crimson halo surrounded it. Scarlet flame played around the spinning wheel like the vivid corona that photographs show around the sun. The observers approved. A new firework had been invented.

But the familiar ones are the favorites. Makers vie with each other to produce the loudest firecracker, the most brilliant Roman candles, the most varied effects in rockets and bombs. At Staten Island I learned how they do it

What puts the bang in a firecracker? If you break one, its powder, when lighted, sizzles harmlessly. You may guess that the cracker explodes violently because the powder is confined. But that is not all.

The secret of a firecracker's bang, it turns out, lies in the little air space that is left within the bright red case. Thus the cracker is not completely filled with

Bombs bursting in air lighted Washington Monument at President Hoover's inauguration last year.



Above, fitting fuses to bombs in a fireworks plant. They are fired from an iron mortar buried in the ground. The lower photograph shows a beautiful nighttime view of Niagara Falls, with a searchlight playing on it while an exploded bomb scatters colored stars.

powder. When the fuse ignites the powder, explosive gases first fill the air chamber. Then, having developed sufficient pressure, they suddenly burst the cracker with the sort of bang that makes it impossible to sleep late on the Fourth.

Spilling and lighting the powder used in the big "salute" crackers is risky. Even when loose it produces enough of a flash to suggest the wisdom of keeping at a distance. The loud report of the newer crackers is the result of a recent advance in powder-making. Contrary to popular impression, old-fashioned "black powder" is not used in many modern firecrackers. Makers have discovered that adding filings of certain metals such as aluminum, and its near relative, magnesium, will put a healthy "kick" in the old-fashioned cracker. Many other fireworks, too, owe much of their brilliance to these new metallic powders. "Sparklers" are mixtures of aluminum and iron dust held together by a suitable binder. The metal dust burns and makes the brilliant sparks.

Roman candles also have been improved by modern discoveries. Watching a workman load a sheaf of them with powder and balls in one of the tiny buildings, I learned how they work.

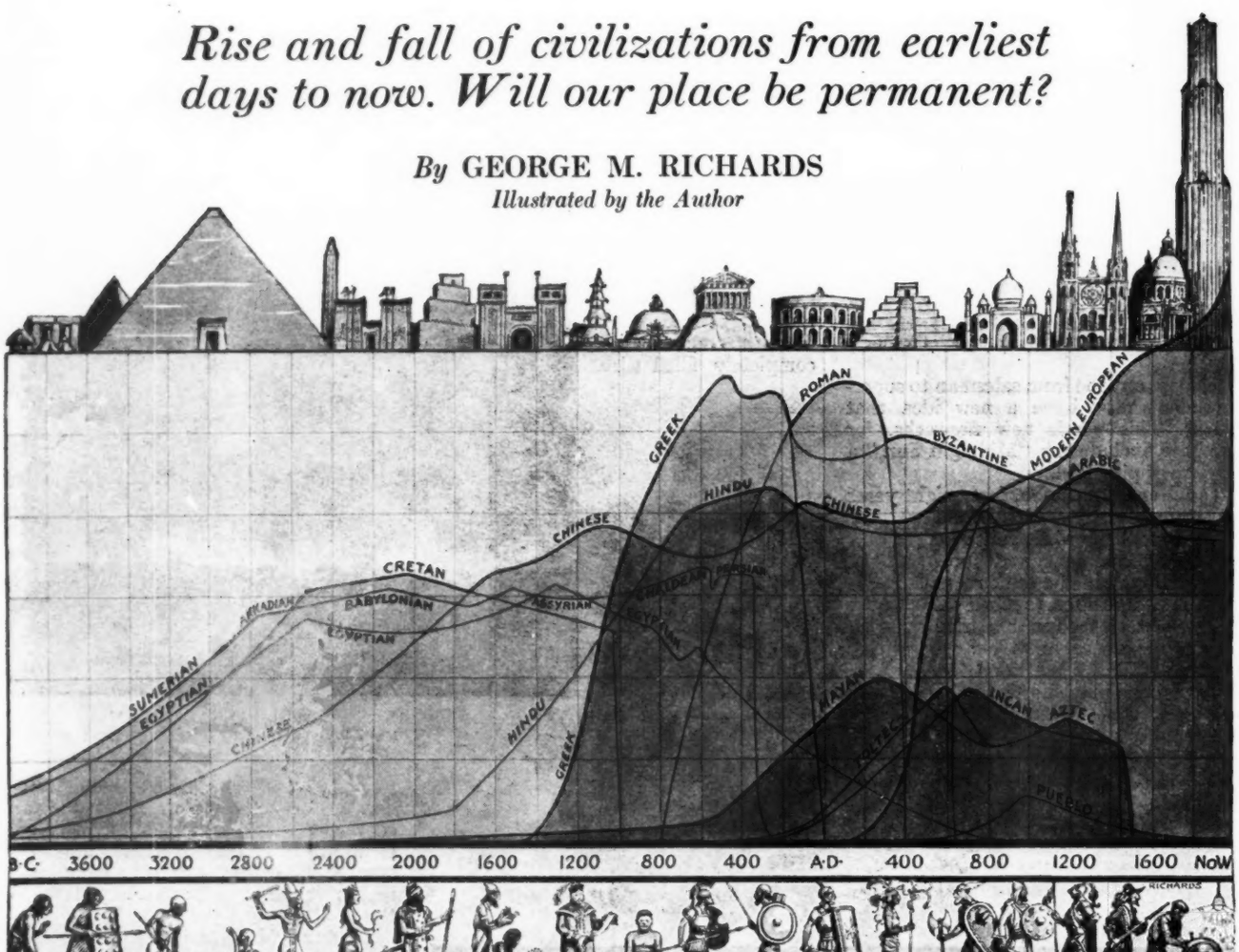
A slow-burning powder emits the first shower of sparks. This powder is really a fuse. It burns down slowly until it strikes the first ball or "star."

Stars are disks that look like overgrown pills, usually grayish or yellowish. They are pressed from a fast-burning mixture of chemicals, including a salt of some metal to give the color. Lighted with a match in (*Continued on page 134*)

World's History in One Picture

Rise and fall of civilizations from earliest days to now. Will our place be permanent?

By GEORGE M. RICHARDS
Illustrated by the Author



This remarkable graph, prepared with the assistance of eminent authorities, shows how great peoples of the past developed civilizations that could not endure. Even the rise of Greece and Rome was temporary. Today Europe and America have reached a high plane; will their culture prove permanent?

MOST persons are familiar with the graphs printed during the last few months on the financial pages of the newspapers to indicate the rise and fall of the values of stocks and bonds. In the same manner, the graph reproduced here attempts to give a summary of the ups and downs of civilization.

In it the various races and nations of mankind have been classified in three groups, indicated by the three tones of gray. The darkest gray indicates the races native to North and South America, the medium tone races known as Aryan which originated in Central Asia and migrated to Europe, while the lightest gray includes peoples of Asiatic or North African stock. The vertical measurements of the graph represent, on an arbitrary scale, the comparative achievements of the races of mankind in their struggle toward an ideal state. The drawings above the graph represent the progress various races have made in one typical art—architecture, while those below indicate what typical individuals of the ascendant races looked like.

Of course any such comparison of civilizations is open to controversy, even if based, as this is, on the opinion of eminent authorities. For example, many readers doubtless will consider the Greek civilization a higher one than that of the subsequent Romans, while those who are more interested in methods of government and state organization will take the opposite stand. There doubtless will be others also to quarrel with the sharp upward sweep of the modern European line at the end of the graph, representing the recent development in the domain of applied science.

As far as possible an effort has been made to average these various kinds of growth, in case of doubt giving more importance to the progress in social organization and practical achievement, since in these elements we have a more definite basis of measurement than in the intellectual and spiritual realms.

Perhaps few realize that previous to the Greek civilization, there existed a powerful, stable, and cultured empire centered in the Mediterranean island of Crete, the material development of which was unexcelled at the time and more modern in spirit than that of any other race for centuries to come. Any speculator of the period would have bet heavily on this gilt-edged stock of antiquity. But, as may be seen in the graph, Crete's assets were wiped out practically overnight by a cataclysm of nature and the invasion of continental barbarians.

When Constantine the Great ruled the Roman Empire in the fourth century A. D., Greek and Roman institutions were merged, resulting in the Byzantine Empire, which continued more or less solvent for hundreds of years, though paying smaller and smaller dividends to culture until the Moslems forced it to the wall.

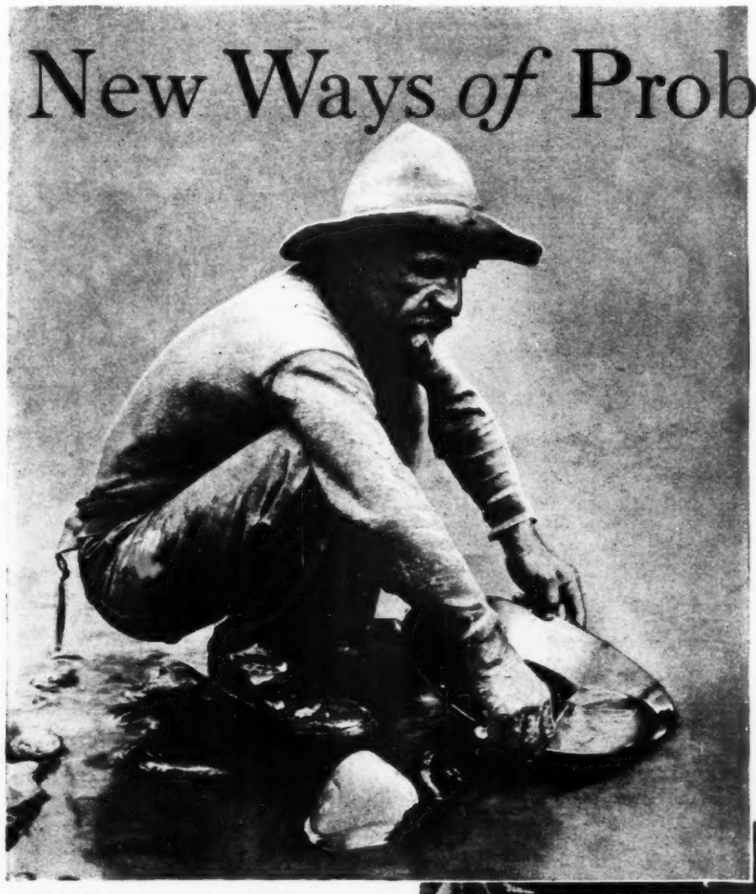
During this period of unsettled conditions in the Eastern market, a bear raid was started by the modern Europeans on the stocks of Aztec and Incan development in America which led to one of the most spectacular collapses of history.

One feature, shown with startling clearness in this graph, should provide food for study and speculation. That is the slow rise and long-continued high level of culture (*Continued on page 123*)

New Ways *of* Probing Old Earth *for* Gold

Modern "sourdough" flies to mine site and sends electricity into earth to find rare metal. Your security depends upon this strange type of prospector, for more gold must be found.

By
ARTHUR CHAPMAN



The old-time prospector with his pan was content to wash his gold out of the sand.

Today swift airplanes carry the gold hunter direct to the location of his scientific operations.

BACK of every dollar in your pay envelope stands a gleaming yellow fortune in metallic gold. Whether you put in your time tilling the soil, working in a factory, or as a doctor or a lawyer, the number of dollars you get for an hour's work depends on the stock of gold on hand.

That is why alarm at the rapid dwindling of the once great army of prospectors and the consequent possibility of a gold shortage has brought science and the United States Government to help the prospector.

A policy of encouraging prospecting was adopted last year in Alaska, and has brought quick returns. Not only was all possible information given to prospectors, but even more practical aid was extended in the building of trails. In that way the greatest possible service was rendered to prospectors who had staked claims where transportation was difficult, if not impossible, without help.

Alaska's gold production increased approximately $1,000,000 last year, and the Secretary of the Interior, in his latest report, says that this increase was largely due to the encouragement of prospecting.

Other governments, notably Canada, are doing even more than the United States to encourage prospectors to take the field.

In order that business stability may be insured, the economists say that the annual increase in the gold should be not less than three percent. Any material falling off in the production of gold will result inevitably in fewer dollars in the pay envelope and a general era of falling prices.

Equipped with headphones, and using a current supplied by induction, the prospector can find the metal beneath ice, snow, and rocks.

Already the possibility of a gold shortage has led the economists to sound warnings. Men like Professor Irving Fisher of Yale and Professor Gustav Cassel of Stockholm have agreed that there must be an increase in the gold supply to prevent a possible era of falling prices within the next decade. Economy in the use of gold is being advocated and practiced by leading bankers in gold-standard countries.

Of course if gold were used only for money there would be no chance for shortage, because money gold does not evaporate or disappear; but gold meets many industrial demands and is used in many manufacturing processes aside from

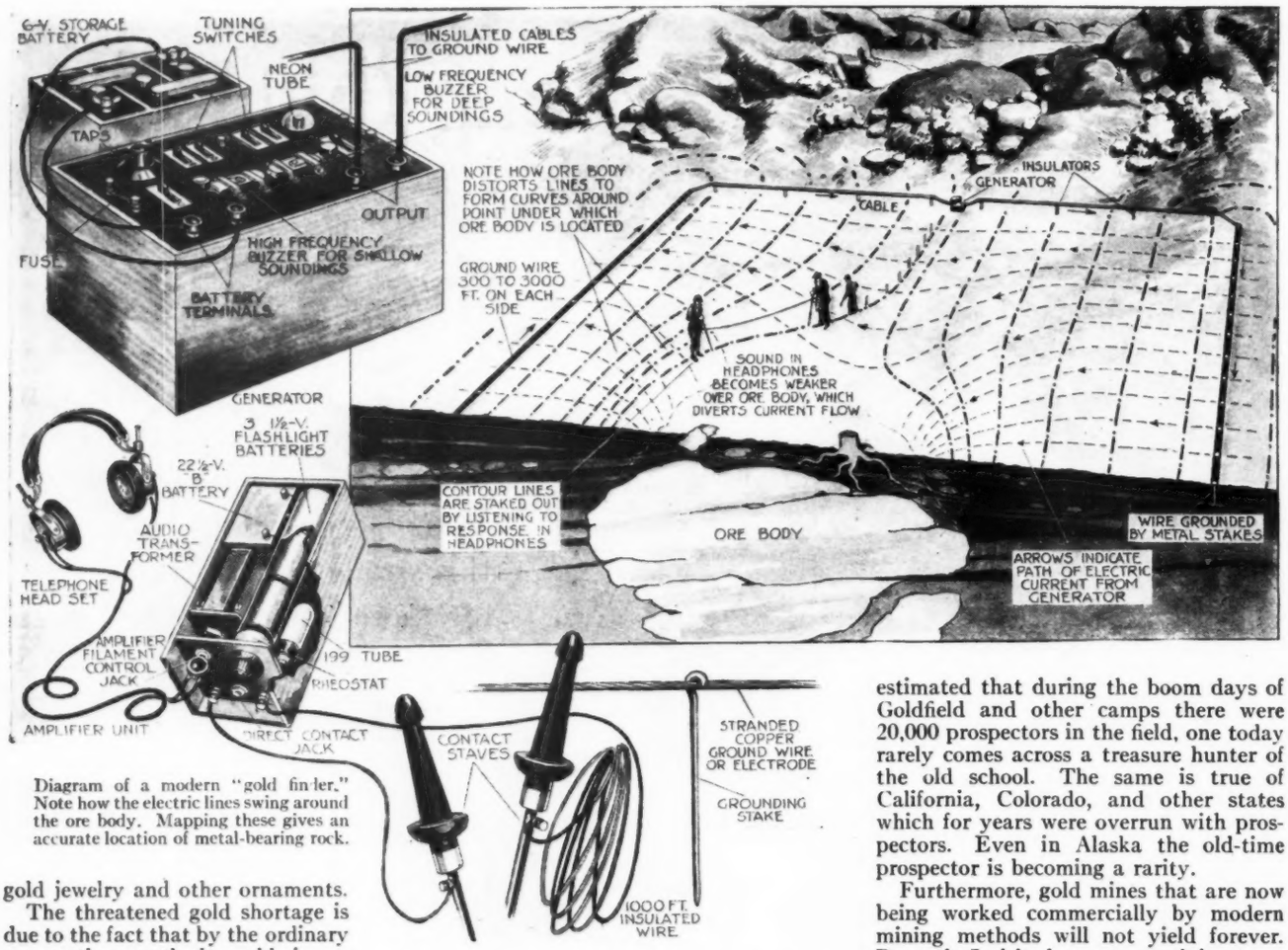

6-V. STORAGE BATTERY
TUNING SWITCHES
NEON TUBE
TAPS
OUTPUT
FUSE
HIGH FREQUENCY BUZZER FOR SHALLOW SOUNDINGS
BATTERY TERMINALS
GENERATOR
3 1½-V. FLASHLIGHT BATTERIES
22½-V. B BATTERY
AUDIO TRANSFORMER
TELEPHONE HEAD SET
AMPLIFIER FILAMENT CONTROL JACK
199 TUBE
RHEOSTAT
AMPLIFIER UNIT
DIRECT CONTACT JACK
INSULATED CABLES TO GROUND WIRE
LOW FREQUENCY BUZZER FOR DEEP SOUNDINGS
NOTE HOW ORE BODY DISTORTS LINES TO FORM CURVES AROUND POINT UNDER WHICH ORE BODY IS LOCATED
GROUND WIRE 300 TO 3000 FT. ON EACH SIDE
INSULATORS
GENERATOR
CABLE
SOUND IN HEADPHONES BECOMES WEAKER OVER ORE BODY, WHICH DIVERTS CURRENT FLOW
CONTOUR LINES ARE STAKED OUT BY LISTENING TO RESPONSE IN HEADPHONES
ORE BODY
WIRE GROUNDED BY METAL STAKES
ARROWS INDICATE PATH OF ELECTRIC CURRENT FROM GENERATOR
CONTACT STAVES
STRANDED COPPER GROUND WIRE OR ELECTRODE
GROUNDING STAKE
1000 FT. INSULATED WIRE

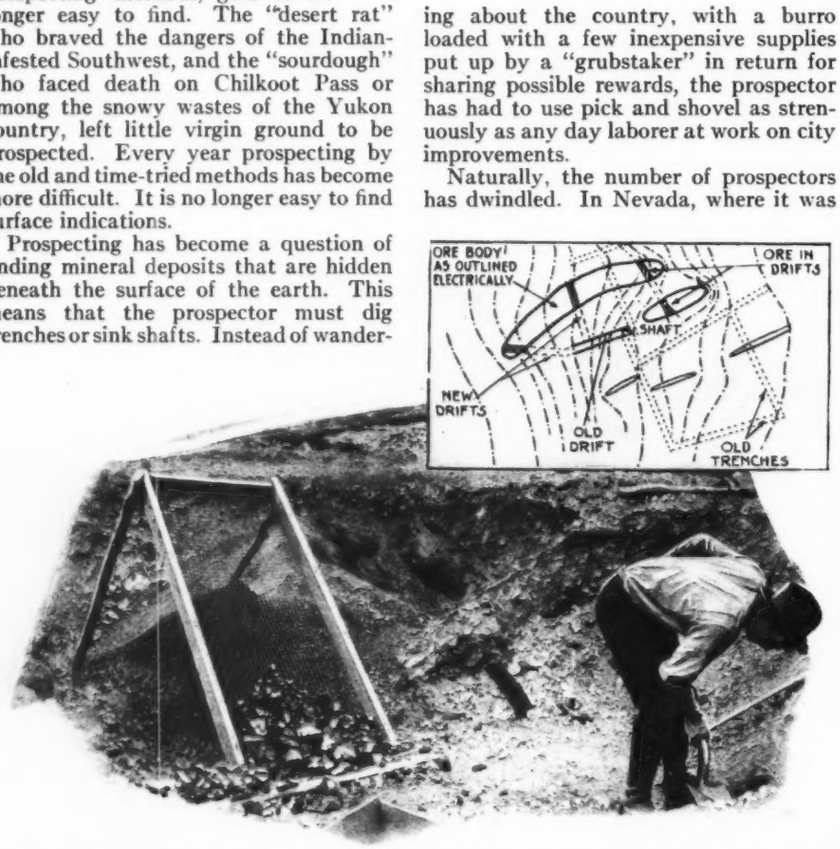
Diagram of a modern "gold finder." Note how the electric lines swing around the ore body. Mapping these gives an accurate location of metal-bearing rock.

gold jewelry and other ornaments.

The threatened gold shortage is due to the fact that by the ordinary prospecting methods, gold is no longer easy to find. The "desert rat" who braved the dangers of the Indian-infested Southwest, and the "sourdough" who faced death on Chilkoot Pass or among the snowy wastes of the Yukon country, left little virgin ground to be prospected. Every year prospecting by the old and time-tried methods has become more difficult. It is no longer easy to find surface indications.

Prospecting has become a question of finding mineral deposits that are hidden beneath the surface of the earth. This means that the prospector must dig trenches or sink shafts. Instead of wandering about the country, with a burro loaded with a few inexpensive supplies put up by a "grubstaker" in return for sharing possible rewards, the prospector has had to use pick and shovel as strenuously as any day laborer at work on city improvements.

Naturally, the number of prospectors has dwindled. In Nevada, where it was estimated that during the boom days of Goldfield and other camps there were 20,000 prospectors in the field, one today rarely comes across a treasure hunter of the old school. The same is true of California, Colorado, and other states which for years were overrun with prospectors. Even in Alaska the old-time prospector is becoming a rarity.



Hard work was the secret of success when the pick and shovel were the only means of discovering gold. Above, diagram of ore body outlined by curving paths of the electric currents.

Furthermore, gold mines that are now being worked commercially by modern mining methods will not yield forever. Recently I visited a western mining town which a few years ago was pouring millions into the coffers of the world. With its output sadly reduced and with empty houses being torn down and carted away for firewood, it was not a pretty sight. Nor is there anything attractive about the once flourishing, but now deserted "ghost camps." Nor about the old placer camps, whose gravel has been turned over and over—once by the red-shirted miners of romance, then by the Chinese, content to find "wages," and then by the giant dredges that scooped out the poor remnants of golden treasure.

The hundreds of years of effort by prospectors and miners have gone to create a supply of gold that is astonishingly small when compared with other products that spelled neither hardship nor unremitting toil.

If the entire gold production of the world since the discovery of America were to be cast into a cube, its edges would measure only thirty-eight and one half feet, Scott Turner, director of the United States Bureau of Mines, recently estimated. This cube has to be kept growing. Sometines its growth has been rapid, and at other times it has been at a standstill. The world's gold production reached its peak in 1915, the output for that year being valued in excess of $470,000,000. Since that time, production has fallen off, averaging annually below the $400,000,000 mark.

Science is now taking a more active hand in prospecting. If things were getting too hard for the old boy with the pick and shovel and (*Continued on page 126*)

Genius Crushed by Patent Laws

Changes in Federal statutes needed to give inventor adequate protection

By ROBERT E. MARTIN

Toiling hopefully through the night hours the inventor dreams of the day when with a patent his troubles end.

IN THE Illinois town in which I grew up there lived a railroad mechanic who spent his spare time working on "inventions" in a shed back of his house. One day we heard he had obtained a patent upon an improved railway switch and had been offered $150,000 for it. All the neighbors dropped in during the evening to congratulate him. Then years passed, while dust accumulated on the patent and the mechanic's hopes faded. All I ever heard was that a "hitch" had developed in the patent.

After talking to inventors, patent attorneys, and Patent Office officials, I realize that the hitch may have been in any one of a dozen places. And such hitches are common.

The average person thinks of an invention as a short cut to wealth—like striking gold or getting a job in the movies. He also believes that a patent granted by the United States Government protects the inventor from infringement, gives him the sole privilege of manufacturing the device he has patented, and proves that he is the original inventor. In all of these particulars, he is wrong.

Once the Government issues a patent, it washes its hands of the matter. It makes no effort to protect the holder against violation of his rights. All it does is give the inventor permission to enter suit against those who use the invention without his consent. Furthermore, most patent holders cannot even manufacture their own inventions without infringing upon someone else's prior patent. The only way you can protect yourself is to go to law and let the courts decide. And, if the patent proves invalid, that's just too bad.

Money is gladly paid for a model because at that time it looks like clear sailing for the device and with a patent cash returns will soon be coming in.

An inventor of St. Louis, Mo., in 1926 applied for a patent upon an electrical device. After a delay of almost two years, due largely to the 118,000 applications which are awaiting action in the Patent Office (P. S. M., June '30, p. 19), his patent was issued.

A manufacturer purchased the invention, and six months later discovered that another company was manufacturing the same device. When sued for infringement, this company proved that the St. Louis man's patent was invalid because disclosures made in a previously issued patent had been overlooked by the examiner who passed on his claims.

By the terms of the agreement, the manufacturer was entitled to demand from the inventor the return of the money he had paid for the patent. The inventor, who had used a large part of it to pay back debts incurred while experimenting, had to borrow money to make the restitution.

SUCH bitter disappointments occur frequently. They should never happen. A patent issued by the United States Government should stand for something. It should have a sounder basis than some examiner's opinion as to its validity. Under the present system the inventor must go through costly litigation to maintain his rights—something the Government should have done for him in the first place.

A patent that has not been through the courts is known as a "green" patent. It is looked upon with suspicion. It has yet to prove its value. In fact, the strength of a patent is gaged by the number of lawsuits it can win.

Consequently, many corporations purposely bring suits for infringement against smaller competitors—who, they know, will make settlement out of court—in order to bolster up a weak patent by a series of court victories. One

The patent attorney's fee also is cheerfully paid for he seems certain that the idea is patentable.

manufacturer, a few years ago, sued himself through a dummy second party, in order to test the validity of a patent before producing the invention.

Confusion results from having Patent Office decisions so frequently upset or reversed by the courts. Nobody knows when he has obtained a patent that will hold water.

Today, a patent is not only "a license to litigate;" it is likely also to mean a necessity to litigate. And so, the inventor without large capital behind him is at a disadvantage. Congress should provide the Patent Office with sufficient examiners and equipment to make a much more comprehensive investigation than now is possible in connection with every application. For the decisions of the Patent Office should be final, as near as possible.

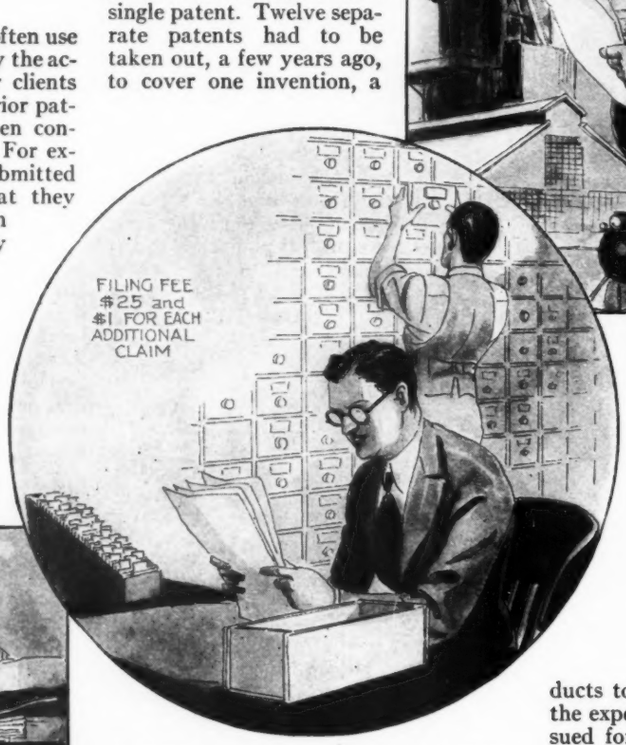
AS IT is now, careful attorneys often use ingenious subterfuges to delay the actual issuance of patents to their clients in order to make sure that all prior patents which may conflict have been considered by the patent examiners. For example, applications often are submitted with intentional misprints so that they will be sent back for correction and thus lengthen the time they are in the examiners' hands. There are several advantages in such delays. First, they tend to "smoke out" conflicting patents. Second, the later a patent is issued, the later, of course, will be its date of expiration, for the life of a patent is seventeen years.

This is highly important in industries which are expanding rapidly, making an invention more valuable every year. Selfish attorneys sometimes realize, too, that an inventor "keeps on inventing," so they delay the issuance of patents on the belief that their clients are more likely to give them further business while previous cases are pending than after the matter has been completed.

Does the patent conflict with others already issued? Your attorney asks an additional fee for a search of the records to justify your claim.

"There is," a leading member of the patent bar told me, "practically no limit to the possible delay in having a patent application considered." He is right. But there should be a limit. Such delays contribute to the disgraceful jam now in the Patent Office, from which, of course, only the inventor suffers. Legislation is badly needed to limit the time attorneys can needlessly delay final action on patents.

Another contributing cause to the present jam is the rule that an inventor cannot cover more than one form of his invention in a single patent. Twelve separate patents had to be taken out, a few years ago, to cover one invention, a fireproof door. The Patent Section of the American Bar Association recently went on record as favoring a change to allow two forms of an invention to be claimed in a single application.



The government takes your check when the application is filed; then your papers are buried under the 118,000 applications which are waiting for action.

A few years ago, a manufacturer in New Jersey installed some patented machines in his factory. They had been in operation only a short while when he was served with papers in a suit charging that the machines were an infringement upon another invention.

"But," the manufacturer protested, "I didn't make the machines. I just bought them from the ..... Company!"

"That doesn't make any difference," he was told, "One who buys and uses an apparatus that infringes upon a prior patent is just as guilty as the man who makes it."

Under present laws, that is true. A customer can be sued and put to embarrassment and expense even before the company that manufactures the device has been sued and before the device has been proved to be an infringement. Thus, inventors who begin the manufacture of their own products sometimes have their business ruined by competitors who scare away their customers with threats of lawsuits. It is common practice to compel the makers of newly-patented products to guarantee that they will stand the expense of litigation if purchasers are sued for infringement. To remedy this situation, a law should be passed to forbid the bringing of infringement suits against the users of patented articles, at least until infringement by the manufacturers of the articles is proved.

When the patent is issued a final fee is paid. You may think your troubles are over but they may just have begun—the courts must be dealt with.

Sometimes an inventor must resort to costly litigation to defend his rights even before his patent is granted. By existing laws, a patent is granted to the first, or prior, inventor. When two or more applications for the same inventon are pending in the Patent Office at the same time, an "interference" is declared for the purpose of ascertaining to whom the patent should be issued. About one percent of all patents that are issued have been in interference. The procedure in interference cases is complicated, prolonged, and expensive. Skilled experts must be hired to give testimony and the highly technical nature of the hearings requires the employment of high-priced patent lawyers to argue the cases. Many appeals are possible.

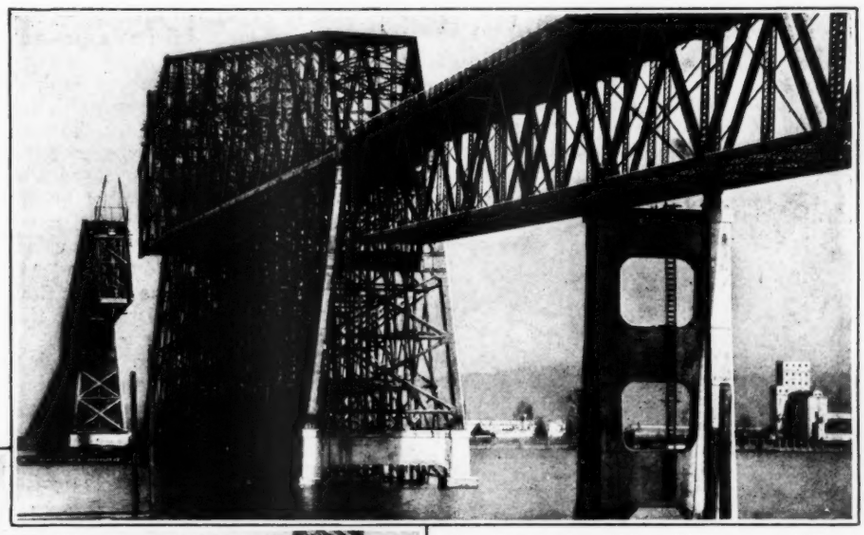
"I PRESUME," one inventor declared, "I have spent not less than $75,000 of my own money (*Continued on page 130*)

PROGRESS AND DISCOVERY

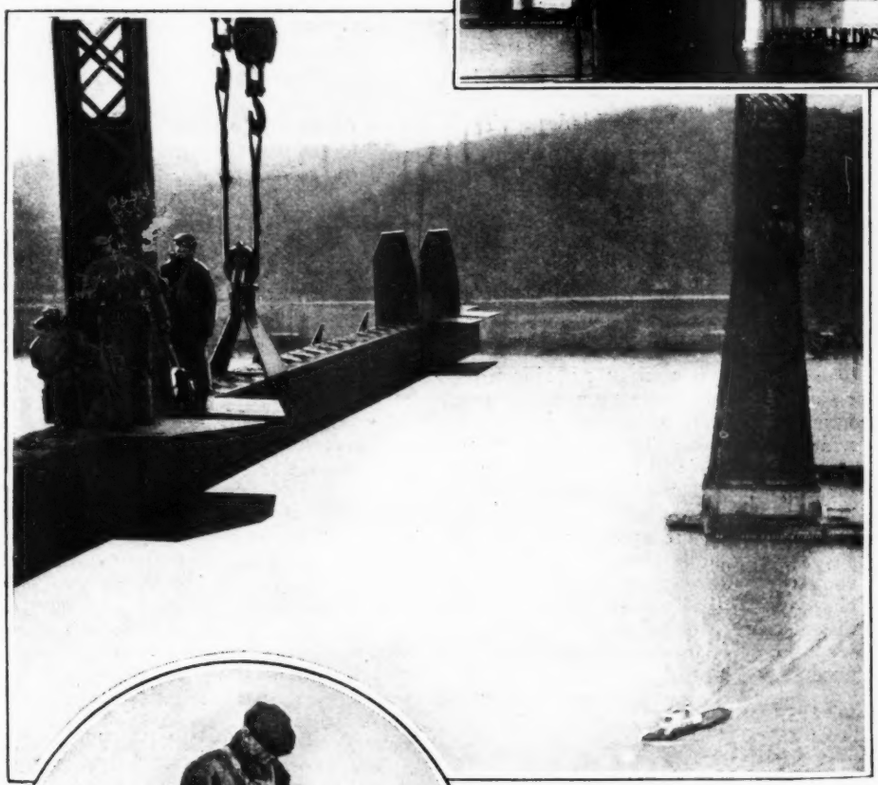
Important achievements in engineering, exploration, and discovery, and the latest news of the world's progress in science

COLUMBIA RIVER BRIDGE SPAN SETS TWO RECORDS

BOASTING the longest fixed span in the United States, a mighty cantilever bridge has been built across the Columbia River at Longview, Wash. To avoid blocking traffic on the main river channel with underpinning, the engineers projected the bridge superstructure 600 feet from each of the two central piers to meet in a 1,200-foot span. It is more than a mile and a half long in all, and is the highest bridge over navigable water in the country. It has a clearance height of 196 feet over the main channel, far more than is needed for the passage of the largest ocean vessels. The bridge is fifty miles inland from the sea and at the exact center of a hundred-mile stretch of the Columbia River which previously could be crossed only by ferry. It cost nearly six million dollars.



View of the bridge while the cantilever section was being built. The timbers seen will be removed.



A steel girder, thrust out into space, is riveted into place in the 1,200-foot span.

During the building of the Longview Bridge, men worked on the steel girders that swung 300 feet above the river. It is the country's highest bridge over navigable water.

The cantilever or "bracket" bridge is favored where many bridge supports would be a hindrance to navigation, or where deep and swift water would make difficult the building of piers. The bridge spans are built out from the foundation piers so that they resemble brackets for a bookshelf. When the brackets meet at the center, a "cantilever" is said to have been formed. In building the Longview bridge, the engineers strengthened the 1,200-foot cantilever span through connections with the two approaches, 760-foot "anchor arms" leading from each bank of the river to the two central piers and giving support to the tons of structural steel being thrust into space. As a connecting link between the Columbia River Highway and the Pacific Highway, two important automobile routes of the Pacific Coast, and other roads now under construction, this bridge will be a valuable asset to western motor traffic.

QUARTZ CRYSTAL MOST ACCURATE OF CLOCKS

ASTRONOMERS now have a new kind of clock. It does not look like a clock at all, as it is merely a tiny crystal of quartz, vibrated about 100,000 times a second by electricity. Every quarter of a minute it records the exact time, correct within a thousandth of a second. This novel time-measuring instrument was developed by Alfred L. Loomis, private experimenter, in a laboratory which he maintains at Tuxedo Park, N. Y.

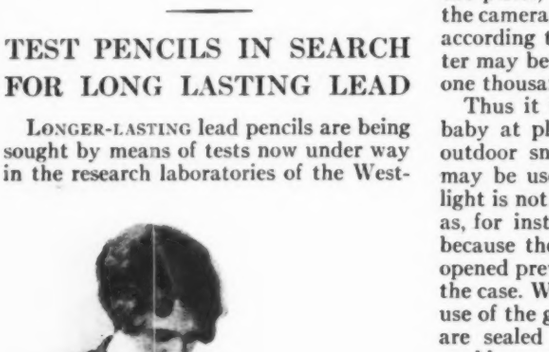
"This way of measuring time," Prof. Ernest W. Brown, president of the American Astronomical Society, said recently, "shows an accuracy that is almost unbelievable. For comparison, imagine that you were asked to measure the circumference of the earth, which is about twenty-five thousand miles. If you could measure it within four inches you would just about duplicate the precision of the new clock."

Astronomers determine exact time by

observation of the stars and then they rely upon clocks to record it. The most accurate clocks heretofore used by astronomers could be relied upon to be correct only within a few hundredths of a second. Professor Brown makes the prediction that the new way of measuring time will "teach us a lot about clocks."

TEST PENCILS IN SEARCH FOR LONG LASTING LEAD

LONGER-LASTING lead pencils are being sought by means of tests now under way in the research laboratories of the Westinghouse Electric and Manufacturing Company.



Four different grades of lead pencils are tested at once on this apparatus, of which a phonographlike disk is the main feature.

The length of life of four different kinds of lead is automatically determined at the same time by wearing down the leads on a paper-covered, electrically-driven phonograph turntable. The four leads, mounted in a pulley-driven disk with equal downward pressure applied to them, also revolve, since if they remained stationary they would write different sized circles and wear unequally. This method is said to test the endurance of the various leads with scientific exactness.

BETTER TIRES IS AIM OF TESTS MADE ON RUBBER

RUBBER is now being tested in a Government laboratory under conditions that reproduce the wear and tear the rubber will meet when it goes out in the form of tires. The rubber section of the United States Bureau of Standards, where the work is going on, is trying to find methods for producing better tires.

Samples of rubber are placed in a new type of "abrasive" machine that wears them down to a certain degree of thinness. The durability of various grades of rubber is determined in this way. The new test is a radical departure from the old method, by which whole tires were worn against a huge metal drum run by an electric motor.

FLASHLIGHT MAKES NIGHT SNAPSHOTS

HIGH-SPEED snapshots at night are easy with a flashlight gun built like a pistol. Squeezing the handle of this apparatus explodes a cartridge of flash powder. At the same instant, a lever in the pistol, through a cable release, trips the camera shutter. So intense is the light, according to the inventor, that the shutter may be set for as brief an exposure as one thousandth of a second.

Thus it is possible to photograph the baby at play in the nursery or to take outdoor snapshots after dark. The gun may be used in daytime whenever daylight is not bright enough for a snapshot; as, for instance, in indoor photography, because the camera shutter need not be opened previous to the flash, as is usually the case. Wind and rain do not hinder the use of the gun outdoors, as the cartridges are sealed within the pistol and thoroughly protected from the weather.

The photograph at the right shows how the flashlight gun is used in conjunction with a hand camera.

New flash gun and camera which it clicks, at the instant trigger fires flashlight cartridge.

TWO NEW ALLOYS HARDEN COPPER

RAZOR blades and scissors may now be made from copper, one of the softest of metals in its pure state. The development of two copper alloys, both hard enough to maintain a sharp edge, makes this possible, according to a recent report to the Engineering Foundation. The first alloy is a mixture of silicon (the chief element in ordinary sand), manganese, and copper. Manganese is a grayish white metal resembling iron but not magnetic. It is well known as an ingredient of alloys, being present in considerable amounts in manganese steel. The new alloy was hit upon by Charles B. Jacobs, a metallurgist of the Du Pont company, who was searching for a fairly cheap metal that would resist acids. His discovery of a metal that would hold a razor blade edge was an accidental by-product of his work.

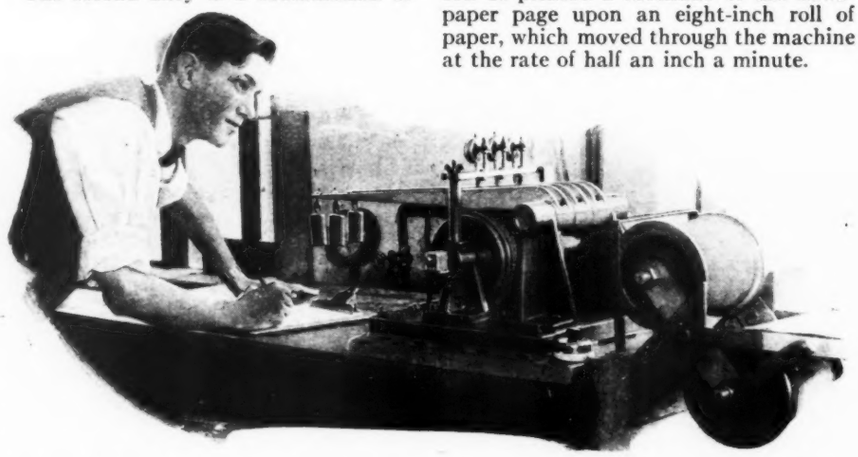
The second alloy is a combination of copper, silicon, and nickel. It is the outcome of researches by Michael G. Corson, of the Union Carbide and Carbon Corporation. It is tempered by being held at 450 degrees of heat for several hours until it is enduringly hard.

NEWSPAPER OF FUTURE MAY GO BY RADIO

HISTORY was made the other day when the front page of a San Francisco newspaper was flashed 2,500 miles from that city to Schenectady, N. Y. Three hours after the paper left the presses, engineers of the General Electric Company at Schenectady were reading the radio transmission of it.

The paper was "delivered" in three eight-inch strips, which were pasted together. The strips were sent much in the same manner as photographs that are dispatched by radio, but the transmission was speeded up.

The receiver which was used was a device no larger than an ordinary suitcase, attached to a standard radio receiving set. It printed a facsimile of the newspaper page upon an eight-inch roll of paper, which moved through the machine at the rate of half an inch a minute.



W. L. Holt, of the rubber section of the United States Bureau of Standards, is watching the abrasive machine that is used to test durability of rubber. One step in the plan to get better tires.

WHOLE HISTORY OF WORLD TO BE SEEN IN MUSEUM

ONE billion, five hundred million years of life on earth are to be brought before the public eye in a vast panorama now being assembled in the Field Museum of Natural History in Chicago. Starting with the earth as it was even before the origin of the first tiny cell, the exhibit will carry the observer down the ages. How life arose from a single-celled animal too small to be seen with the naked eye, and as the centuries wore on took the various forms of fish, reptiles, mammals, and finally emerged as a man, will get graphic presentation in the Museum's display. The story will be told by fossil remains, by life-size groups of prehistoric peoples, and sculptured representatives of the present races.

There will also be exhibits showing the influences on human society of racial intermarriage, and the effects of various diseases. Huge wall paintings will illustrate scenes of everyday life in prehistoric ages.

OIL SOLIDIFIED BY LIQUID AIR

How the searing cold of liquid air, which is ordinary air changed to a liquid more than three hundred degrees Fahrenheit below zero by chilling and pressure, turns substances ordinarily fluid into steel-hard blocks was recently shown in a striking New York demonstration. A small amount of tung oil, or Chinese wood oil, was almost instantly frozen solid by exposure to liquid air. So hard was the resulting bar that, used as a wedge, it could be hammered to split pieces of wood.

Many other materials display unusual properties when chilled to such low temperatures. Steel, for example, that is tough and elastic at ordinary temperatures becomes almost as brittle as glass. Even rubber becomes so brittle that it flies to pieces when struck with a hammer.

Oil, turned to a steel-like substance in the cold of liquid air, is used, in demonstration, to split wood.

VARNISHED AUTO PLATES FADE OUT QUICKLY

VARNISHED auto license plates do not remain legible as long as unvarnished ones, is the conclusion reached by the United States Bureau of Standards, at Washington, D. C., which has been trying to find out why some license plate numbers fade more quickly than others. Those in charge of the investigation gave painted plates a coat of varnish. Another group was left unvarnished. Both batches were then subjected for thirty-seven days to exposure in a special weathering machine. Curiously enough, the dull plates stood up better under the test.

FLYING BOATS TO FIGHT FIRES

FLYING fire engines are the latest creation in the world of aviation. They will be used in fighting forest fires, according to a report from the Department of Commerce in Canada. The government there has ordered five all metal flying boats. Each will carry two pilots, a mechanic, and seven firemen.

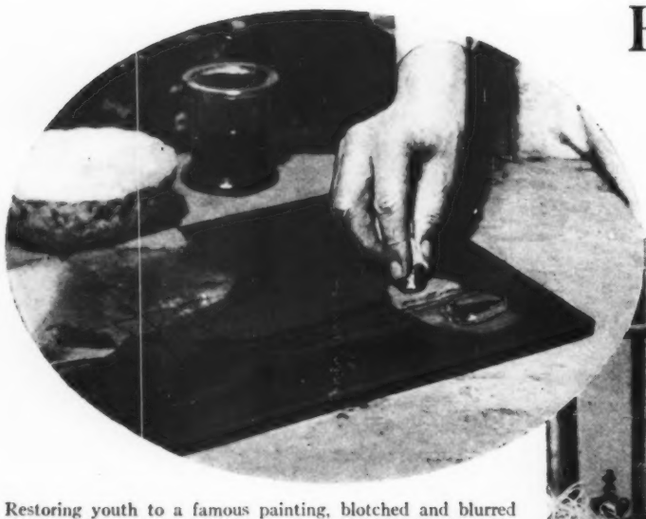
LONDON TRIES TO DIVERT TRAFFIC TO RIVER TAXIS

A NEW solution of a big city's traffic problem is being tried in London, England. River taxis are being used to relieve the congestion of the crowded streets. In recent speed tests, the fast boats proved their ability to make regularly scheduled runs. They are expected to transfer a considerable part of London's traffic from its narrow and crooked streets to the broad expanse of the River Thames. Similar suggestions have been made for New York City, where the Hudson and East Rivers could be used.

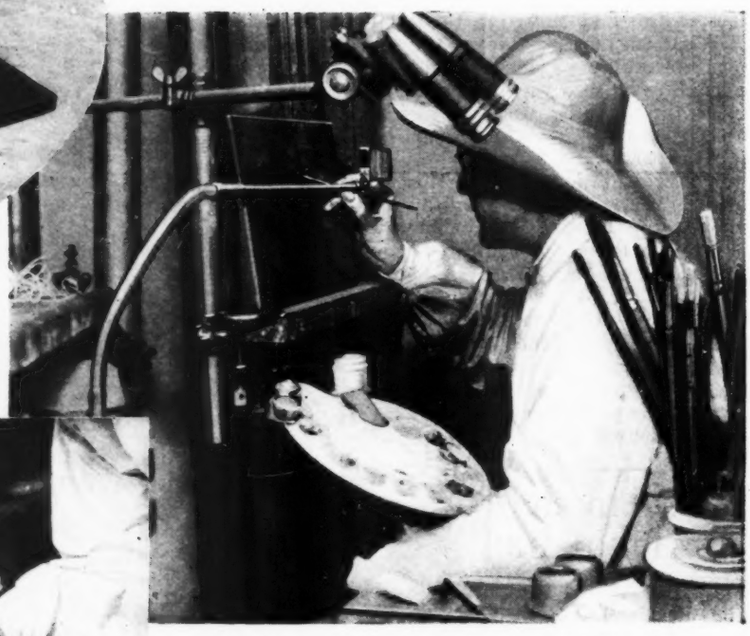
HUGE TELESCOPE MIRROR MADE IN GREAT HEAT

WHEN in the future astronomers using the gigantic 200-inch telescope now being constructed for the California Institute of Technology get an enlarged vision of the universe, it will be due partly to a new process for making quartz glass mirrors. To make a smooth quartz surface for the huge telescope's reflector, big enough to cover the floor of a room seventeen feet square, has been one of the chief problems confronting those engaged in the work, according to Dr. Elihu Thomson, of the General Electric Company. It was a laboratory assistant who suggested spraying the quartz on the reflector, somewhat as paint is sprayed on an automobile body. Experiments proved the idea was a striking success. Quartz, ground into white powder, was shot through an oxygen-hydrogen blowtorch, making a flaming stream that spattered the mirror backing at a temperature of 3,000 degrees. When the process is used in the fusing of the 200-inch reflector, it is estimated that enough hydrogen to raise a dirigible will be burned.

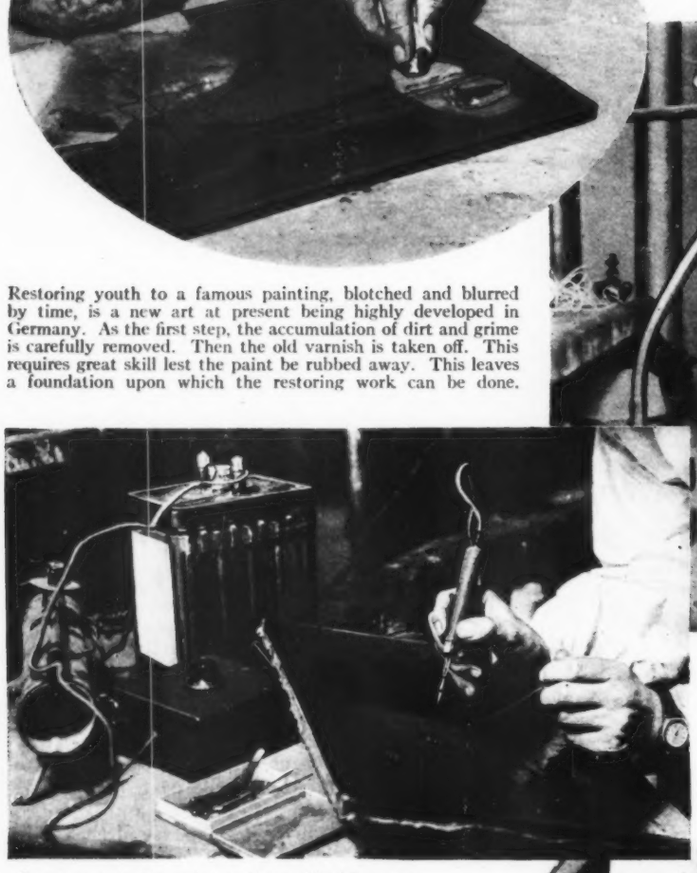
How Pictures, Ruined by Time, are Saved by New Art



Restoring youth to a famous painting, blotched and blurred by time, is a new art at present being highly developed in Germany. As the first step, the accumulation of dirt and grime is carefully removed. Then the old varnish is taken off. This requires great skill lest the paint be rubbed away. This leaves a foundation upon which the restoring work can be done.

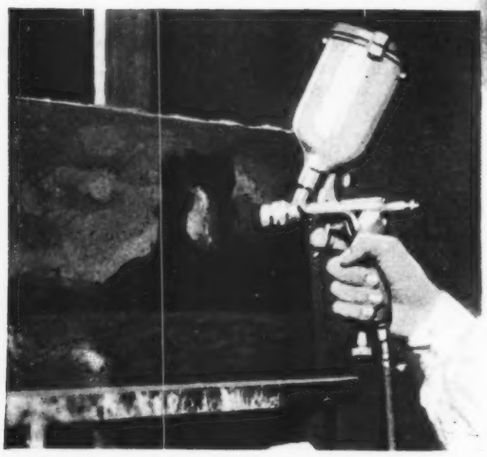


After the warped bits of paint have been pasted in place, a real artist gets busy at the delicate job of retouching so that the original colors are restored to the picture with such skill that none of the detail is lost. This work is done under the powerful light of thousand-watt bulbs which furnish approximate daylight. Their heat is the excuse for the big straw hat the artist is wearing. In order that nothing on the canvas will be missed, this process is done under a magnifying glass.



In many cases the paint on these old pictures has cracked and loosened from the canvas. As the second step, these warped patches of color are raised so that their under surface can be coated with a special cement. They are then returned to their original places in the detail of the picture. The utmost precision is necessary to see that they are returned exactly to the spot from which they are removed. An electric hot needle is used in this work.

An ordinary electric iron is also used in this restoration business. After the patches of paint have been lifted and again pressed down, the iron is used to force them more thoroughly into place and to insure the proper setting of the cement. Even this is a job for a skilled workman, as care must be taken to see that there are no blisters.



After the patching and repainting, the masterpiece is given a coat of varnish, which protects against wear and tear of weather and handling. A spray gun is used to do this work and great skill is required to insure a perfectly even distribution of varnish over the surface.

Last step of all in this new life operation is a careful study of the picture through a stereoscopic microscope, an instrument that not only magnifies but also gives the scene dimensional depth. This step requires the services of an expert, who checks the picture in detail to see that colors, tone, and feeling, as they existed when the old master finished the painting, have been perfectly restored.

Air Photos Made by Army Pigeons

TINY aerial photos, snapped by a little camera attached to a carrier pigeon, are being made in Germany, where these birds are trained for military purposes. One of the small cameras, fastened to a pigeon's body, can take six automatic snapshots while the bird is in flight. They give views so clear and accurate that they can be used as the basis for military maps and charts. Thus another office, that of the air photographer, is assigned to the birds that were found to be of great value during the World War.

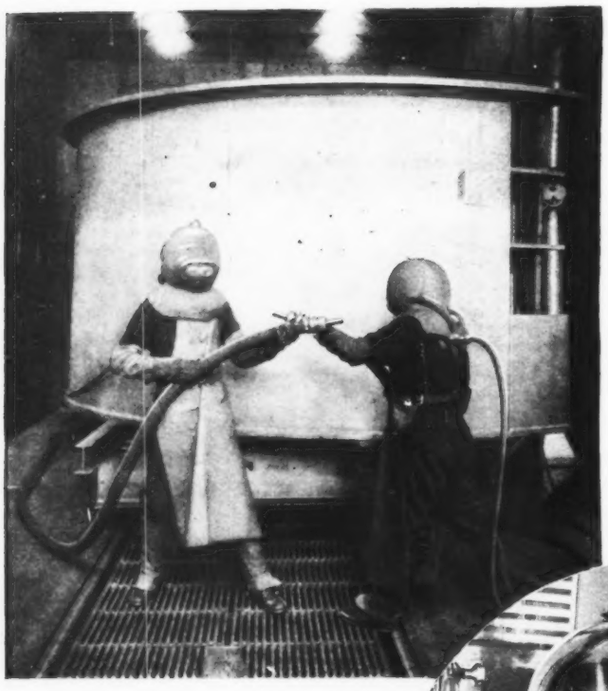
A carrier pigeon has been known to carry a message as far as 1,040 miles, but one hundred miles is said to be as far as should be attempted with pigeons under a year old. The average rate of flight is thirty-seven miles an hour. During the war the messages were made on a fine paper or film and inclosed in a goose-quill capsule. This was attached by a waxed silk thread to a feather in the pigeon's tail.

Here are a few of the German army's pigeons out taking their daily dozen. Exercise is an important part of the birds' training, especially since their use in military operations has become general, as the value of their services depends upon their ability for sustained flight.

This carrier pigeon is ready to set out on a map making trip through the air. The tiny automatic camera is attached to it and as the bird flies, the shutter opens and closes six times, thus making photographs of the terrain which are later used as guides in the drafting of accurate maps for the army.

This messenger dog is just as necessary as the pigeons themselves in the use of carrier birds. Pigeons fly back to their lofts and nowhere else, and the dogs are needed to carry them in panniers to the field where they are released for their uncannily accurate homeward flight.

At the left, a picture taken by a carrier pigeon with an automatic camera while it was flying home. Note that on each side of this remarkable photograph the tips of the bird's wings were caught by the lens as the tiny shutter clicked.



SHOT FIRED AGAINST STEEL TO CLEAN IT

A SCENE suggesting a fantastic stage setting is enacted daily in a remote room of the General Electric Company's plant at Schenectady, N. Y. There, under the glare of powerful lights, gnomelike workmen scour large steel castings to prepare them for a coat of paint. Hoses in their hands discharge a continuous, clattering volley of fine steel shot upon the part being cleaned. In this dusty atmosphere, the men must wear headgear like divers' helmets, with fresh washed air supplied to them continuously through tubes from outside the room.

A hundred pounds of steel pellets are fired every minute from the air guns. This shot is recovered, separated from the dust loosed by its impact, and utilized over and over again until it has been worn down to a fine powderlike mass.

MACHINE TO READ IS INVENTOR'S GOAL

A MACHINE that can read a book aloud is the goal of Robert Naumberg, German inventor. He seeks to perfect such an instrument as a means to entertain the blind, though it probably would have to spell out each word.

The "visagraph," the device on which he is working, employs a pencil of light the width of a printed letter. This ray runs along a line of print from left to right. Each letter, Naumberg explains, is a little blacker or lighter than any other in the alphabet. An electric eye responds to the letters' brightness by sending varying amounts of electric current through a keyboard arrangement, which in turn will utter corresponding sounds of the human voice.

More widely useful for the majority of persons who like to be read to is a "talking book" recently invented by Dr. C. H. Hewlett, of the General Electric Company (P.S.M., May '30, p. 61). This device, really a portable talking movie outfit, reads to its user steadily for an hour and twenty minutes. Records might also be obtained that would render a full-length play, opera, or concert. This device, however, requires special records.

BLACK LIGHT DETECTS FORGERY IN CHECKS

How the denomination of a check may be marked with invisible ink as a protection against check raisers and the unseen writing revealed by "black rays" recently was demonstrated by Dr. Herman Goodman, of the New York Academy of Medicine. When a "raised check" was placed beneath the rays of a new type of lamp he has developed, the writing glowed, revealing the forgery.

The lamp was a new type for producing invisible ultra-violet rays, otherwise known as "black light." A dark pane of blue-black glass, tinted with nickel and cobalt, effectively cuts off visible light. Certain substances, however, glow beneath the rays, and one of these was used in the invisible ink.

Originally Dr. Goodman developed the lamp to detect skin diseases invisible under the microscope. But he also suggests several commercial uses for the device. One is the possible detection of the source of bootleg liquor. Plants that manufacture industrial alcohol might add a substance to it that would glow red, blue, or white under the ultra-violet rays. One color would be assigned to each locality. An examination of bootleg liquor would show whether its alcohol had been diverted from an industrial plant.

SHIP WILL GENERATE POWER FOR CITIES

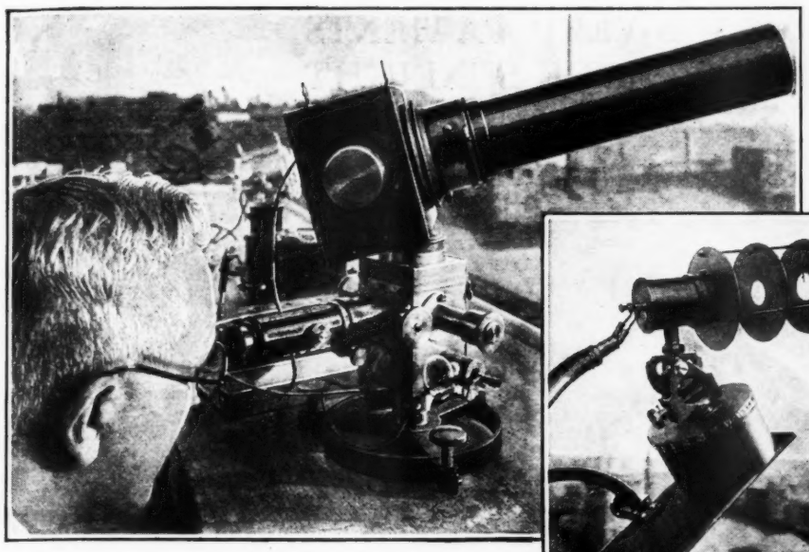
SOON New England is to have the first regular floating power station. The New England Public Service Company has just purchased the obsolete cargo ship *Jacona* from the United States Shipping Board. Modern steam turbines and generators are to be installed so the ship can generate electric power for cities situated on the coasts of Maine and New Hampshire.

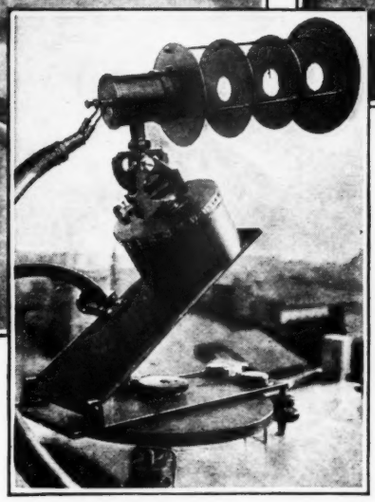
Not long ago the plan of supplying power from a ship was shown to be practical. When shortage of water for hydroelectric power threatened to shut down factories in Tacoma, Wash., the United States Navy's airplane carrier *Lexington* went to the rescue. Electric cables were laid from the ship to the shore, and for thirty days the *Lexington's* 180,000-horsepower generators fed power into the city wires (P. S. M., Apr. '30, p. 45).

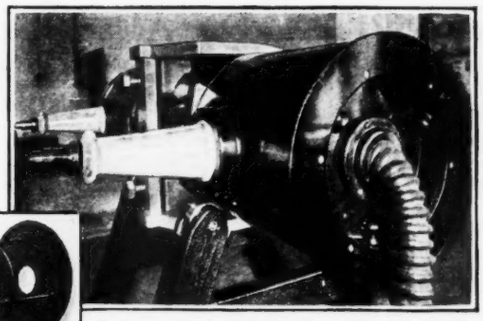
NEW AIR TORPEDO HAS NO CREW

A TORPEDO that flies without a crew and rains death from the skies is the latest in warfare. Reports say that England is perfecting such a weapon. Built like an airplane, every pound of lift would be used to carry high explosives. The machine would be directed toward an enemy position and released. Of its own accord it would take the air and fly over the enemy lines. Clockwork controls would stop the engine at a predetermined moment, and the "flying bomb" would crash to earth.

Another war terror, an "invisible torpedo" for submarines, is announced by Prof. Oswald Flamm, German naval architect. Hitherto warships have been able occasionally to dodge torpedoes, but the new weapon will take a ship by surprise. Professor Flamm offered his plans to a European government. Germany, forbidden by treaty to build submarines, cannot use Flamm's plans.







At left, on the roof making a record of the ultra-violet rays in sunshine and the instrument that measures heat. Above, X-ray machine.

EFFECT ON LIFE OF UNSEEN RAYS IS STUDIED AT BERLIN

THERE may seem to be no possible connection between X-rays and seaweed, but the exposure of low types of life to rays of all kinds is one of the experiments being made at the University of Berlin, in the "ray laboratory." There physicists are seeking to determine just how various forms of life are affected by the invisible heat rays, light rays, ultra-violet rays, X-rays, and even the super-penetrating rays of radium. Medicine and biology may profit by the work being done in the new laboratory.

Its fourteen varieties of X-ray apparatus suggest the completeness of the laboratory's equipment. Its pride is a thousand-watt lamp for producing ultra-violet or "black light" rays, one of the most powerful of its kind in the world. A meteorological station on the roof of the three-story building measures the amount of heat and of ultra-violet rays received daily in natural sunshine.

SMOKE MASKS OF 1664 AND 1930 COMPARED

THERE were smoke masks as early as 1664, but they were not much protection against smoke. What 266 years have done for these masks is shown in this unusual photograph of three types of helmets, preserved in a Berlin museum.

Nearly three centuries lie between the smoke mask on the left and the 1930 model, with oxygen tank attached, on the right.

The earliest type, shown at the left, had an air tube crossing the top of the mask and hanging from the back of the wearer's head. The type shown in the center left much to be desired in the way of vision. At the right is the 1930 model. The wearer carries his own oxygen supply, and wide-lensed peepholes ensure a good view of anything that might be ahead.

ELECTRIC TRAINS RUN WITH NO CREW ABOARD

ELECTRIC trains without crews—in fact, with no human being aboard—will soon haul rock for cement making from quarry to crusher at a Dallas, Texas, plant. When the cars have been loaded, they will appear to start of their own accord for the crusher. At their destination the motors cease humming, brakes go on automatically, and the train stops.

Just like toy electric trains, these industrial strings of cars are controlled from a distance. Two operators, one of them placed where he can see the loading of the cars and another at the receiving end, control their movement by electric switches. General Electric Company engineers worked out a "remote control" system in which any section of track may be electrified; by turning the current into all of them the train is made to run from one end to the other.

Running downhill, the driverless train does not speed up. The motors of the cars automatically turn into generators and feed electric current back into the third rail, helping to drive the other cars.

"WORLD" PHONE BOOK OUT IN DENMARK

THE first "world telephone directory" has just appeared in Denmark. It lists the names of between 50,000 and 60,000 subscribers in many countries who make habitual use of international telephone lines. Editions in English, French, and German are available.

Growing networks of telephone lines that link all the countries of the world have made such phone books necessary. The latest addition to the chain is telephone service, via radio, between the United States and South America. President Hoover recently opened the new line by telephone conversations with the presidents of Chile, Uruguay, and Argentina.

POWERFUL DRUGS FOUND IN VENOM OF TOAD

MIGHT a toad cure heart disease? Yes, if he is treated in the right way, according to a recent medical discovery. Extract from glands that lie behind the eyes of a toad found in the river and lake regions of China contains four chemical substances that have a beneficial medical effect. These substances were isolated at Johns Hopkins Medical School by Dr. H. Jensen and Dr. K. K. Chen, the Chinese chemist who produced from an old Chinese drug plant the drug "ephedrine," now widely used in treating colds and hay fever. Two of the substances separated out of the toad's glands were found to have an effect on the action of the heart, similar to that of digitalis, a drug now generally used to strengthen the heart muscle. The sonorous names "cinobufotoxin" and "cinobufagin" have been given to the new drugs. The first of these is so powerful that one thousandth of a gram (100 such doses would be required to equal the weight of a single bird seed) would kill an ordinary cat.

Toad venom has for centuries been used in China to cure canker sores, sinus trouble, certain inflammations, toothache, and bleeding gums. The venom proved effective in stopping bleeding and in draining infected sinuses, Dr. Chen found, because it contains a certain amount of adrenalin, the chemical substance which raises blood pressure. Ordinarily this is extracted from the adrenal glands of animals.

HOSPITAL ON AIRSHIP MAY SWEEP PATIENTS ABOVE CLOUDS IN QUEST OF MORE SUNLIGHT

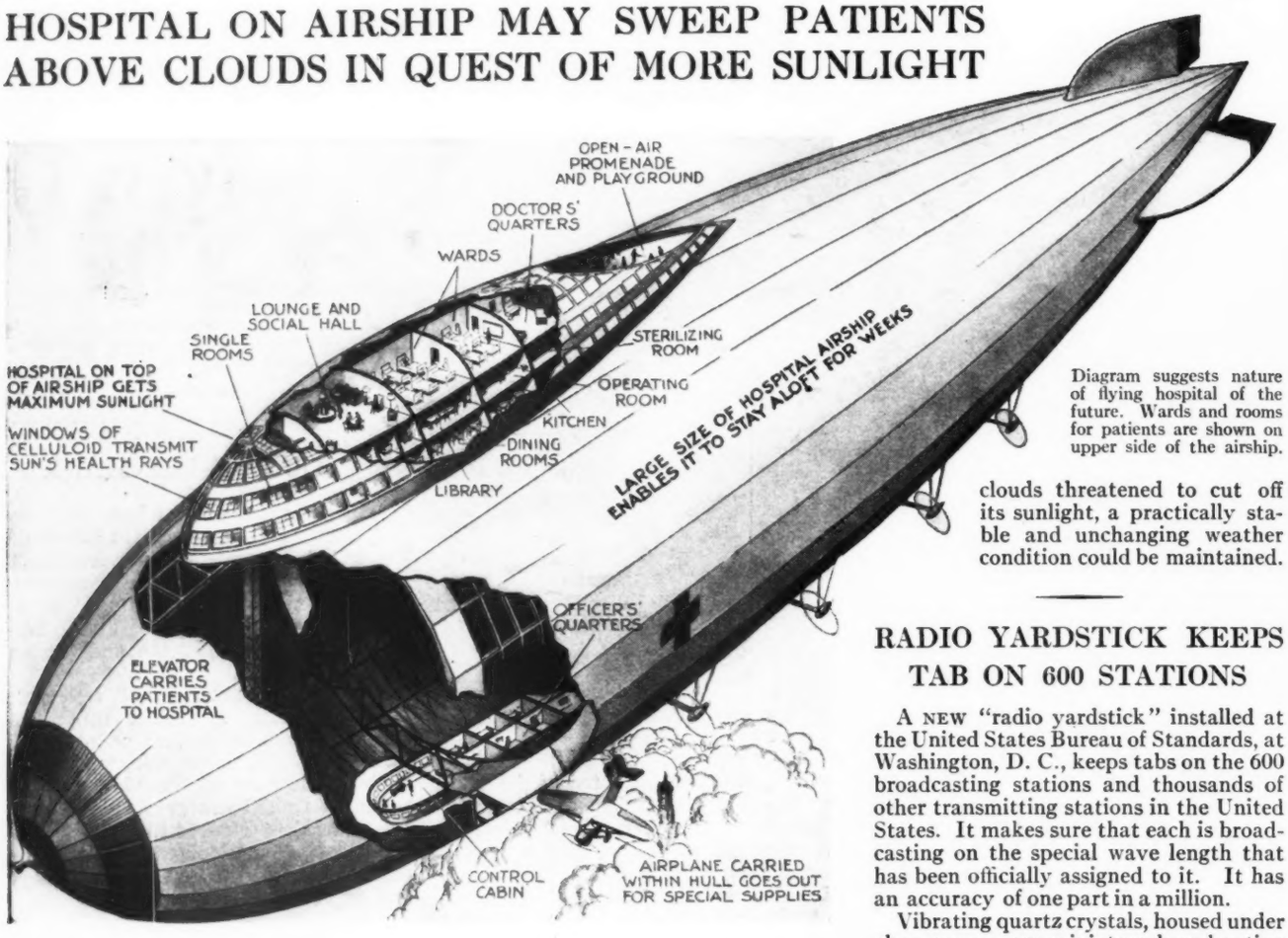


Diagram suggests nature of flying hospital of the future. Wards and rooms for patients are shown on upper side of the airship.

FOR persons suffering with tuberculosis, or just from nerves, will physicians soon prescribe a trip to the clouds in a flying clinic instead of a visit to the mountains?

Not long ago Charles L. Julliot, French lawyer, proposed that airplanes or dirigibles transport such patients above the clouds. His suggestion, which America hears was approved by the medical faculties of France, called attention to the fact that high altitude and sunshine produce well-known changes in the blood, in many cases beneficial. Add to this the natural exhilaration of an air trip, he says, and the effect might be even better than that of a mountain vacation (P. S. M., Mar. '30, p. 34).

Dr. Karl Arnstein, vice president and chief engineer of the Goodyear-Zeppelin Corporation, and the man in charge of building the Navy's great new airships at Akron, O., has described for POPULAR SCIENCE MONTHLY just how this hospital airship might be designed. The drawing of the "flying clinic" shown above was prepared from data supplied by Dr. Arnstein.

Like a huge blister, on top of the airship, would rise the aerial sanatorium, with suitable provision for the care and comfort of the patients. In that position it would receive the full benefits of sunlight. Its walls and roof would be studded with windows, the panes made of celluloid or some similar material which transmits the healthful rays of the sun. Glass would be ruled out because of the danger of breaking and the added weight.

In shape and probably in size the body of the airship would follow the design of the two 6,500,000-cubic-foot airships being built for the Navy. A hospital airship of this size would be able to stay aloft for weeks at a time. An airplane carried inside its hull could maintain communication with the ground and if necessary make trips for special medicines and supplies.

The skipper of such an airship would maneuver his craft according to the weather. By cruising about to dodge storms, and soaring upward whenever clouds threatened to cut off its sunlight, a practically stable and unchanging weather condition could be maintained.

RADIO YARDSTICK KEEPS TAB ON 600 STATIONS

A NEW "radio yardstick" installed at the United States Bureau of Standards, at Washington, D. C., keeps tabs on the 600 broadcasting stations and thousands of other transmitting stations in the United States. It makes sure that each is broadcasting on the special wave length that has been officially assigned to it. It has an accuracy of one part in a million.

Vibrating quartz crystals, housed under glass covers, are miniature broadcasting stations that emit waves of exceedingly exact frequency. These waves are taken as standard and compared electrically with those of commercial broadcasting stations. Any discrepancy between the two produces a whistle, and the musical pitch of the whistle is an exact measure of the amount by which the station is off its proper wave length. In order to keep the quartz crystals at a constant temperature, ensuring their accuracy, they are housed in a heat-insulated chamber resembling an ice box.

Six hundred broadcasting stations are tested by this radio yardstick installed in the radio laboratory of the Bureau of Standards. Dr. J. Dellinger, chief of the laboratory, inspects the crystal controller.

At left, the parachute that is opened by an explosion is being packed in six separate chambers. At right, model plane thrown from tower is being gently lowered to the ground by the blast-opened parachute.

Ernest V. Stone, inventor of a parachute to float whole plane, points out the spark plugs used to ignite powder and open 'chute.

POWDER OPENS 'CHUTE THAT SUSTAINS PLANE

GUNPOWDER opens the newest parachute, designed to lower an entire plane safely to earth. In case of trouble, the pilot of a mail or transport plane pulls a convenient trigger. From the rear comes the sharp report of an explosion. A parachute flutters from the plane. Its folds billow full of air, and in a second the entire plane is swinging gently to the ground.

This device, invented by Ernest V. Stone, of Long Beach, Calif., was demonstrated recently with the aid of a dummy plane. Stone carried the dummy, a wooden frame about five feet long, to the top of a high tower. A string was attached to the trigger, to operate it during the "plane's" fall. Then the dummy was tossed from the tower. Instantly there was a puff of smoke and the parachute unfurled itself.

To avoid any possibility of failure to be released, folds of the parachute are packed in six individual explosion chambers. The gunpowder in each is fired simultaneously at the pressing of the trigger, a specially-developed type of electric spark plug igniting it.

This probably is the most radical of any parachute developed to sustain an entire airplane, but it is not the first one. Several experiments with giant plane-carrying parachutes, as large as seventy-two feet in diameter, have been made in California (P.S.M., Sept. '28, p. 67; July '29, p. 26). The most recent test of parachuting a whole plane, at San Mateo, Calif., using twin 'chutes, nearly cost the life of the pilot when one of them became entangled with the plane (P.S.M., Feb. '30, p. 73). Stone's new powder-driven 'chute is intended to obviate this danger.

LINDBERGH CHARTS NEW COAST-TO-COAST ROUTE

WHEN Col. Charles A. Lindbergh recently flew from Glendale, Calif., to Roosevelt Field, N. Y., in fourteen hours and forty-five minutes, smashing all existing coast-to-coast records, he opened a new lane to air traffic. The new airway is a course three miles above the earth, where favoring tail winds speed a racing plane.

It was to test the existence of such winds at high altitudes that Colonel Lindbergh made his record-breaking dash. The entire trip was made between altitudes of 14,000 to 15,000 feet, which the famous pilot found free of storms and atmospheric disturbances. Mrs. Lindbergh, a passenger on the flight, assisted in the navigation of the plane.

The previous record for a coast-to-coast flight was seventeen hours and thirty-eight minutes, established last July by Capt. Frank M. Hawks in a nonstop coast-to-coast flight. In beating this mark Lindbergh demonstrated the curious fact that a transcontinental plane which makes one stop can better the time of a nonstop machine. He made one stop at Wichita, Kan., for fuel and oil, while Captain Hawks's flight was without a stop. The reason for this apparent paradox is that to cover the entire distance from coast to coast in one hop requires an excessive fuel load. By traveling lighter, Lindbergh attained an actual flying speed estimated at 170 miles an hour.

OVERSHOES FOR PLANE LESSENS ICE DANGER

RUBBER "overshoes," designed to prevent formation of ice on the forward edge of a plane's wings, were demonstrated successfully the other day at a Cleveland, Ohio, airport. The invention consists of a flattened strip of rubber tubing fastened along the leading edge of the wings. Impregnated with oils, it resists formation of ice. A valve in the cockpit will also inflate the tube with air, stretching it and breaking up layers of ice upon it.

TINY MOTOR AIDS GLIDER IN CROSS-COUNTRY TEST

IN A GLIDER of thirty-six-foot wing spread, equipped with an auxiliary two-cylinder gasoline motor, Stanley C. Huffman recently flew from Cincinnati, O., to New York City. He covered the 570 miles—making one stop on the way for fuel—in ten hours. The trip cost him less than $10, he figured after measuring the gasoline and oil consumed.

The latest in gliding is these machines with tiny motors, to keep them aloft if the upward winds that glider pilots depend upon to sustain them should fail. Unlike motorless craft, they take the air under their own power without the aid of a tow. They are ideal craft for the man who wants to fly, but cannot afford to buy or to run a full-sized airplane, according to Kenneth M. Lane, chief engineer of the United States Department of Commerce's Aeronautics Branch. Safer for the novice to handle than a large airplane, they may be landed at low speed with correspondingly less chance of accident.

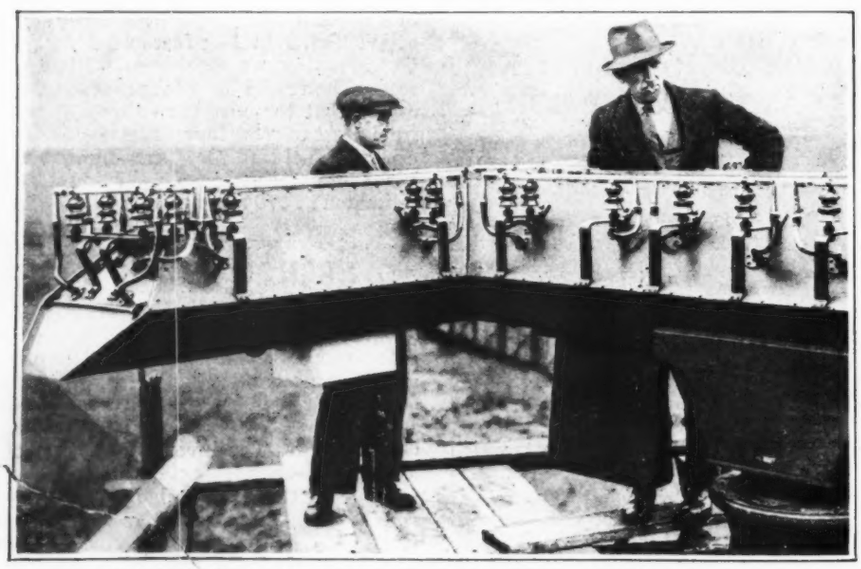
Several "powered gliders" of this type are already on the market. The machine which Huffman flew is only twenty-two feet long. It is said to take off after a run of fifteen or twenty feet on the ground, and to climb as easily as an ordinary airplane. Like others of its type, it can soar for long distances with the thirty-horsepower motor shut off.

A powered glider which flew from Cincinnati, Ohio, to New York is seen here over the city at the end of the flight.

Paul Gillespie, of New York City, in the powered glider, ready to take off on a trial flight from Roosevelt Field.

CROYDON INSTALLS NEON LIGHTED WEATHER VANE

A GIGANTIC, blazing red weather vane to guide pilots by night to the landing field, and indicate the direction of the wind so that they will know from what angle to approach the field, has been set up recently at Croydon, England. The unusual contrivance is a huge metal "T" that swings with the wind on a large tripod base. It is equipped with powerful, red neon lights which are said to be able to pierce fog to a considerable distance.



Huge T-shaped wind indicator which has been set up at the Croydon airport to guide pilots in landing. It is illuminated with powerful neon lights, which are said to penetrate blinding fog to some distance.

"DIVING BOMBER" ADDS NEW TERROR TO WAR

A "DIVING BOMBER," a type of airplane previously unheard-of in military circles, recently was seen at the United States Naval Air Station at Anacostia, D. C. Officers who watched the first demonstration of the novel plane declared that it introduced a deadly new maneuver in aerial warfare.

The machine, a special Martin bomber with a 1,000-pound bomb hung from its undercarriage, was taken to an elevation of 12,000 feet. Suddenly it dived straight for the earth at four miles a minute. It plunged downward for a mile. Then the pilot easily pulled it back to a level keel.

In actual warfare, Army men said, the pilot could dive straight at his target. A bomb released at that moment would hit its mark with deadly accuracy. Present style bombers are the slowest, heaviest, and unwieldiest of aircraft, and cannot dive rapidly. They fly along on a level course, and consequently cannot gage accurately where their bombs will fall.

The new Martin bomber can maneuver with the fast fighting planes.

REGULAR AIRSHIP TRIPS TO EUROPE BY 1932

THE first commercial air line across the Atlantic seems assured of realization. It will be an airship line. A fleet of four dirigibles, Germany's *Graf Zeppelin* and three more to be built, will open the new service in 1932, according to present plans of the financial group that is backing the project.

The route will be from Baltimore, or some more southerly terminal in the United States, to Seville, Spain, whence airplanes will connect with the principal cities of Europe. A stop will be made at Bermuda.

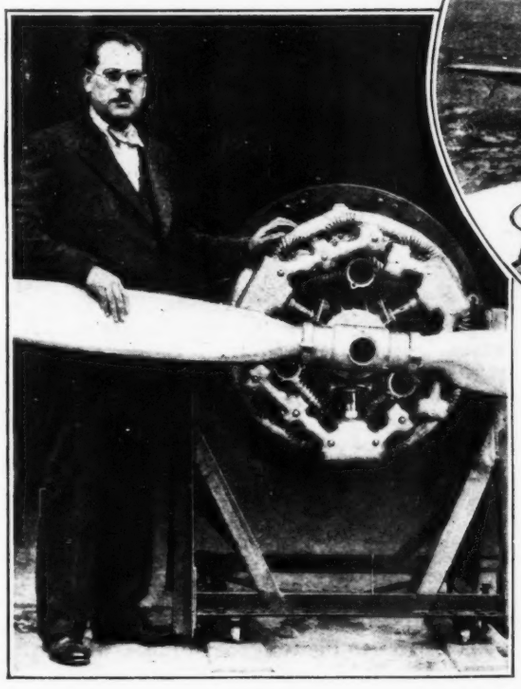
Passenger rates will be double steamer fare. The crossing from America to Spain should require only two days; the return trip westward would be one day longer.

Two of the new airships for the service, modeled after those now being built for the Navy at Akron, O., would be constructed in the United States, and one in Germany. These ships, with engines more powerful than any yet used in dirigibles, are laid out on drawing boards at the Goodyear-Zeppelin airship plant in Akron. Its president, Paul W. Litchfield, is also the president of the new transatlantic line. Among the group of financial and industrial organizations backing the project are the United Aircraft and Transport Corporation and the Dornier airplane interests abroad. Airplane and airship will join in this enterprise.

COFFEE GRINDER RADIO DIAL—The heavy gloves worn by airplane pilots make it difficult for them to turn a delicate dial in picking up a radio station. This device, which looks like a coffee grinder, can be adjusted, when mounted above the throttle, by knocking the handle around until the desired station is picked up.

COMING OUT OF A TAIL SPIN—Only a wing tip stood between Gerhard Fieseler, Germany's premier flyer, and death the other day when he plunged toward the earth in a tail spin near Cassel, Germany. A photographer in another plane near by took this remarkable photo of the barrel-roll maneuver by means of which Fieseler pulled his craft out of the spin that threatened a fatal crash. After regaining control of the machine, he landed safely on the field none the worse for his narrow escape.

HALTS WHIRLING PROPELLER—Blinking lights in this apparatus are adjusted to flash once every time the propeller comes around to the same position. Thus it appears almost to stand still, and its wobbles at high speed can be studied. It also watches and checks vibrating engine valves.



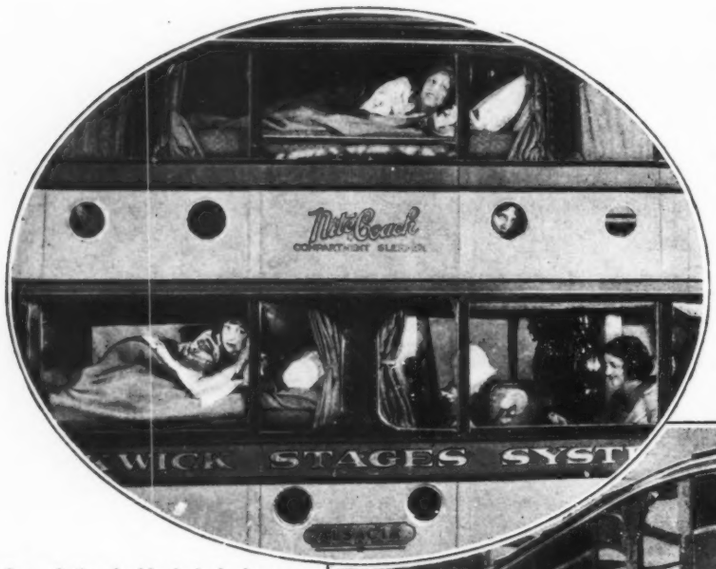
LIGHT PLANE MOTOR—The new airplane engine at left, seen with its inventor, H. A. Beilgard, of Hollywood, Calif., does not stick out into the air current, and so speeds up an airplane. Also it gives the pilot of the plane a chance for an unobstructed view ahead. It has a small facial area, its diameter being only thirty inches. It develops 500 horsepower with a weight of only 525 pounds, which makes it one of the lightest gasoline motors for its power yet designed.

TURNTABLES FOR AIRPLANES—Croydon Airport, England, recently installed a turntable for airplanes. The device is not used merely to point a machine in a new direction, as planes can turn under their own power. It does the far more important work of checking up on the accuracy of the compass. When a plane is rolled on the table, it is turned until it points exactly north. Then the compass on the pilot's instrument board is inspected to see if it also registers due north. In this way any deviation can be corrected. Note the observer with compass directing the alignment of the airplane. The turntable is revolved by hand.

Millions Use New Covered Wagon

Fifty thousand high-powered buses now crisscross the country from coast to coast. They carried 1,768,000,000 persons in 1929. Economy and convenience make them popular with travelers.

By MICHEL MOK



One of the double-decked sleeper and diner buses which maintain regular through service between Los Angeles and San Francisco.

Here is the modern stagecoach, ready for a trip. This is one of the latest type transcontinental parlor motor coaches that are now used to carry passengers from Atlantic to Pacific, making the trip in six days.

RECLINING in comfortable seats behind thick plate glass windows, 1,768,000,000 passengers, a number almost equal to the population of the world, rode in motor buses along American highways in 1929. An outgrowth of the jitney craze of the years just before the war, the bus has taken the people of this country by storm and has become a vital factor in transportation.

In the big cities, elaborate bus terminals, equipped with all the facilities of railroad stations and swarming day and night with travelers, are springing up like mushrooms. Only about a month ago, the new Central Union Bus Terminal, the largest and most up-to-date indoor motor coach depot in the United States, was opened in the Times Square section of New York City.

The unique feature of this station is a huge turntable, operated electrically, by means of which ten buses can be loaded and unloaded simultaneously. Eventually, two hundred and fifty of the modern covered wagons belonging to eight companies covering every part of the country will be handled daily in the depot, which occupies almost the entire ground floor of the twenty-three-story Hotel Dixie.

The establishment of this seventh large bus terminal in mid-town New York is one of several indications of the tremendous growth of bus travel. Long-distance bus transportation is a development of the last two or three years; coast-to-coast connections are even more recent. Curiously enough, that is about the same period that saw aviation come into its own. While swift, spectacular air routes were being opened for the comparative few, the slower but none the less romantic road cruisers penetrated practically every highway in America for the convenience of millions.

Today the United States is bus-minded. Close to 50,000 motor coaches operated by 6,000 independent bus companies and the railroads are now on the roads. Almost an equal number serve for the transportation of children to schools in rural communities. Last year, every man, woman, and child in the United States made an average of fifteen trips on revenue buses only.

These figures become all the more impressive when it is considered that the first primitive motor bus to be operated on a regular route in the Western Hemisphere lumbered up Fifth Avenue, New York, just twenty years ago. Now you may travel from the Atlantic to the Pacific in Pullman chaircar type buses in five days and twenty-two hours. Crack train service takes four days.

BUT that is not all. The crude contraption that frightened the cab horses on Fifth Avenue in 1910 has grown into a sleek, streamlined, 175-horsepower rolling hotel. Huge sleeper buses, equipped with berths, washbowls, lavatories, and restaurant service for twenty-six passengers, have been in regular operation between San Francisco and Los Angeles for about a year. On May 1, a similar service was established between Chicago and Detroit and between St. Louis and Kansas City.

In the East, sleeper buses were run experimentally in the spring of last year between Cleveland, O., and Buffalo, N. Y. The service, however, proved unprofitable to the Greyhound Lines, which conducted it, and was discontinued.

Service is of prime importance to the modern stage coach. At left, a motor is swinging at the end of the crane ready to go into bus.

Brakes are a big factor of safety to the speedy bus, and frequent thorough inspection is given them. Below, a brake newly adjusted is being tested.

The same company, a few weeks ago, made a new arrangement for those who wish to travel by bus in the daytime but do not want to doze in reclining bus seats at night or lose time by stopping at hotels. In conjunction with the Pennsylvania Railroad, it created a coördinated bus-rail-sleeper service. Thus, for example, one now may leave New York City by bus at noon, arrive in Harrisburg, Pa., at 8:15 at night, there change to a Pullman berth, leave Lima, O., by bus at 11:05 next morning, and arrive in Chicago at 6:40 that evening.

THE fare for this New York-Chicago trip is $32.18. Using the railroad all the way through, the journey would cost a traveler $41.70, nine dollars of which would be for his berth. In other words, the cost of the combined bus-Pullman service is just about that of day coach travel on the train. But the trip by the new system takes thirty hours and forty minutes, while the train time ranges from twenty to twenty-six hours.

The cheapness of bus travel is, of course, one of the main reasons for its popularity. Here are some random examples of fares charged from New York City by one of the leading companies: To Cleveland, $12.50; to St. Louis, $23; to Milwaukee, $23; to Chicago, $20.50; to Detroit, $16; to Denver, $41.50; to Indianapolis, $18; to Omaha, $31.50; to Niagara Falls, $10; to Boston, $4; to Portland, Me., $6.50; to San Francisco, $74.

In a majority of cases, the rate is about two thirds of the regular train fare without sleepers. On the other hand, the railroad generally takes only two thirds of the time it requires a bus to make a given trip. Hence, bus travel is ideal for those who have plenty of time to reach their destination and wish to save money.

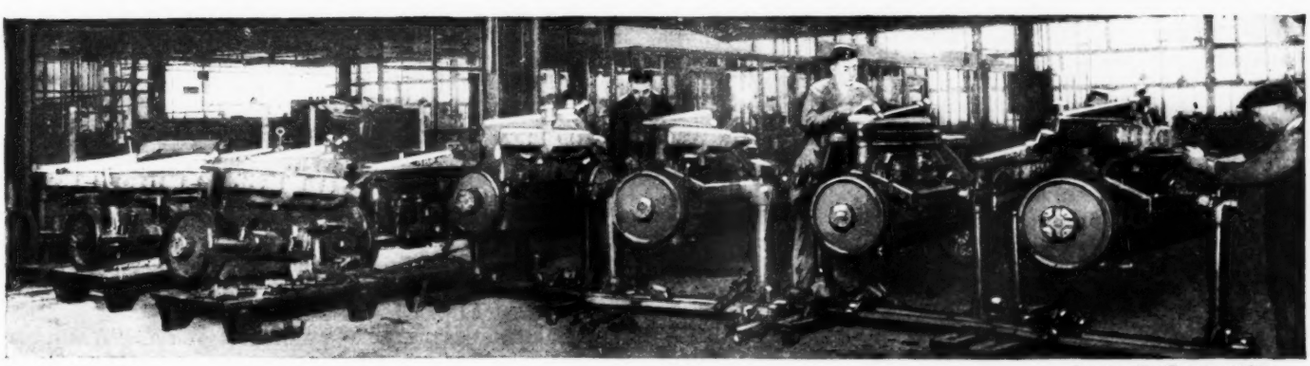
THE matter of price is not the only advantage of bus riding. Buses go to hundreds of places not easily accessible by train. Today, there is scarcely a country store, desert camp, or mountain hamlet that cannot be reached by bus. Moreover, in cases where small towns are linked both by a railroad and a bus line, it frequently happens that buses run oftener. Thus buses not only are convenient for out-of-the-way travel but also offer the tourist a splendid chance, denied all but the automobilist and the hiker, to see every nook and cranny of the country and its people at work and at play.

Then, too, strange as it may seem to some, there actually are thousands of people who, in this age of ever-increasing speeds, prefer a leisurely mode of travel. As a matter of fact, this comparatively new form of transportation has created a new type of passenger. Here is a description of this traveler by Grover W. Gilroy, chief dispatcher of the Greyhound Lines at New York City. Gilroy knows his man, for he carried him over thousands of miles of road in the six years he worked as a bus driver before being promoted to his present job.

"Your bus passenger," Gilroy told me, "is an entirely different fellow from a traveler on a train. He is not pressed for time; else he wouldn't be on a bus. Seven times out of ten he is out for pleasure. So, it stands to reason that he isn't under any strain, and he's determined to make things as pleasant as possible for himself and everybody else.

"HUNDREDS of times I have left a terminal with a load of perfect strangers who were like one big family by the time we got to the other end of the line. It's like people on a ship, I guess. They chat, they swap stories, they sing, they play the ukulele. At rest stops, where we halt for ten or fifteen minutes for refreshments, they get further acquainted. And in time of trouble, they are with the driver to a man. The few times I've been pinched for speeding, they not only razzed the cops but passed around the hat and raised my fines among themselves. And when you have a blow-out, there are always men on the bus who know about cars and volunteer to help you change. You never need to ask."

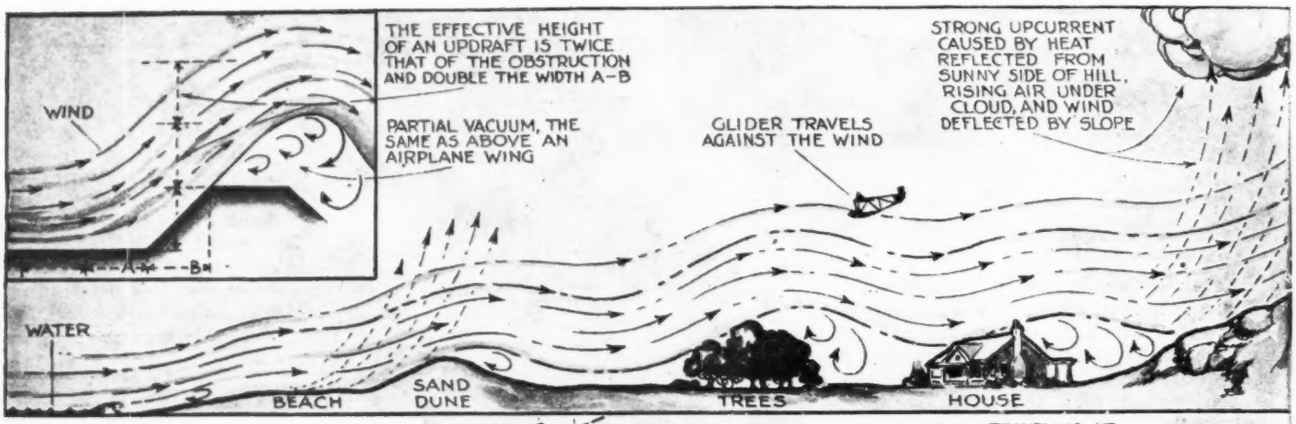
On a recent trip I took on a night bus of the New England Transportation Company from New York City to New Haven, Conn., I had a chance to observe that a modern motor bus is, indeed, a miniature democracy on wheels. True, there were no blow-outs or cops to test the loyalty of the passengers to the driver. But by the time we had left the city, most of the occupants of the bus had become more or less acquainted. Men talked politics; swapped Army experiences. Someone, in a low voice and tentative manner, started an old song, and soon some of America's favorite barber shop ballads, in close harmony, floated (*Continued on page 127*)



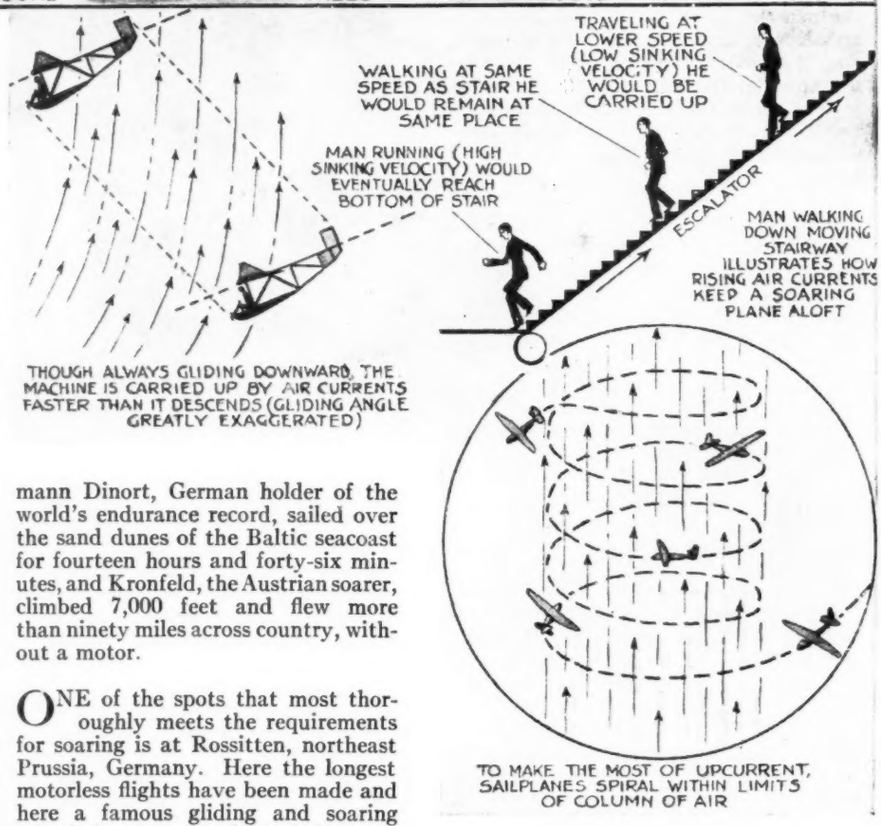
Courtesy Bus Transportation

The engine overhaul department of the largest service plant in the world, located in Philadelphia, Pa. In this shop the motors are put in condition to insure the management that each will give ninety thousand miles of consecutive operation on the highways.

Picking a Gliding Site


THE EFFECTIVE HEIGHT OF AN UPDRAFT IS TWICE THAT OF THE OBSTRUCTION AND DOUBLE THE WIDTH A–B
WIND
PARTIAL VACUUM, THE SAME AS ABOVE AN AIRPLANE WING
GLIDER TRAVELS AGAINST THE WIND
STRONG UPCURRENT CAUSED BY HEAT REFLECTED FROM SUNNY SIDE OF HILL, RISING AIR UNDER CLOUD, AND WIND DEFLECTED BY SLOPE
A
B
WATER
BEACH
SAND DUNE
TREES
HOUSE

How wind and heat cause rising air currents strong enough to carry a sailplane aloft.


WALKING AT SAME SPEED AS STAIR HE WOULD REMAIN AT SAME PLACE
TRAVELING AT LOWER SPEED (LOW SINKING VELOCITY) HE WOULD BE CARRIED UP
MAN RUNNING (HIGH SINKING VELOCITY) WOULD EVENTUALLY REACH BOTTOM OF STAIR
ESCALATOR
MAN WALKING DOWN MOVING STAIRWAY ILLUSTRATES HOW RISING AIR CURRENTS KEEP A SOARING PLANE ALOFT
THOUGH ALWAYS GLIDING DOWNWARD, THE MACHINE IS CARRIED UP BY AIR CURRENTS FASTER THAN IT DESCENDS (GLIDING ANGLE GREATLY EXAGGERATED)
TO MAKE THE MOST OF UPCURRENT, SAILPLANES SPIRAL WITHIN LIMITS OF COLUMN OF AIR

By

EDWIN W. TEALE

ANY sloping hill that is free from trees, brush, fences, and other obstructions is suitable for ordinary gliding. For beginners, only gentle slopes should be used. The height of gliding hills ranges from ten to a hundred and fifty feet. A practice hill does not have to be high. For instance, William B. Stout, airplane designer and general manager of the airplane division of the Ford Motor Company, has taken up gliding and flies his machine from a small knoll near his home in Detroit. Recently he made a thirty-second hop from this little hill, qualifying for a third-class glider pilot's license.

The ideal gliding spot is a high knoll with slopes that face in all directions so that the glider can take off into the wind no matter from which direction it blows. Otto Lilienthal, the great German pioneer, had an artificial hill of this type made in the middle of a level field. At the top of the great mound he dug a cave to form the "hangar" in which he stored his batlike machines. While few modern glider enthusiasts can afford artificial hills from which to fly, they can often find natural ones that slope in several directions. If not, an elevation that faces the prevailing wind should be selected.

WHILE the finding of a gliding place is relatively simple, the requirements for soaring territory are much more difficult to fill. A horseshoe-shaped range of hills or sand dunes with the concave side facing the prevailing wind forms an ideal soaring place. Here, the wind striking the sides of the ridges is deflected upward in a strong rising current that carries the sailplanes aloft. By jockeying the light craft from one rising air current to another, the pilot may succeed in soaring for hours at a time, apparently defying gravity. Thus, Hermann Dinort, German holder of the world's endurance record, sailed over the sand dunes of the Baltic seacoast for fourteen hours and forty-six minutes, and Kronfeld, the Austrian soarer, climbed 7,000 feet and flew more than ninety miles across country, without a motor.

ONE of the spots that most thoroughly meets the requirements for soaring is at Rossitten, northeast Prussia, Germany. Here the longest motorless flights have been made and here a famous gliding and soaring school is run. A long half-moon, formed by a chain of high sand dunes, extends out into the Baltic Sea. The prevailing wind sweeps inshore and strikes the dunes. If the wind shifts slightly it is still blowing into the half-moon and the pilot does not have to land, as is the case when he is flying over a straight ridge and the wind veers. The Rossitten dunes are from 130 to 150 feet high and drop at an abrupt angle to the water's edge.

Because of the soft sand, into which the keels of the gliders often sink six inches on landing, special greased runways have been constructed for starting from these dunes. Several men stretch out the rubber cable attached to the glider's nose while others hold back on the tail. At the pilot's command, those in the rear let go and the light machine shoots into the rising air currents. As the glider rapidly sails aloft, the cable drops from its nose.

Even more famous than the dunes of the Baltic, as a soaring ground, are the Rhoen Mountains, where the annual motorless flying meet is held. The highest peak, Mount Wasserkuppe, towers about 2,000 feet above the plain to the north and is surrounded by smaller hills.

PILOTS who take off from the side of this mountain often are carried more than 1,000 feet above its peak by the strong air currents. One sailplane pilot took off from the side of this mountain and a few minutes later landed at its top. It was from this peak that Johannes Nehring, then the youngest on the Darmstadt College glider team, won a

Rolling hills and rising currents needed to make your sailplane ride the wings of the wind. This article tells in detail what to look for in slope and elevation when choosing your launching field.

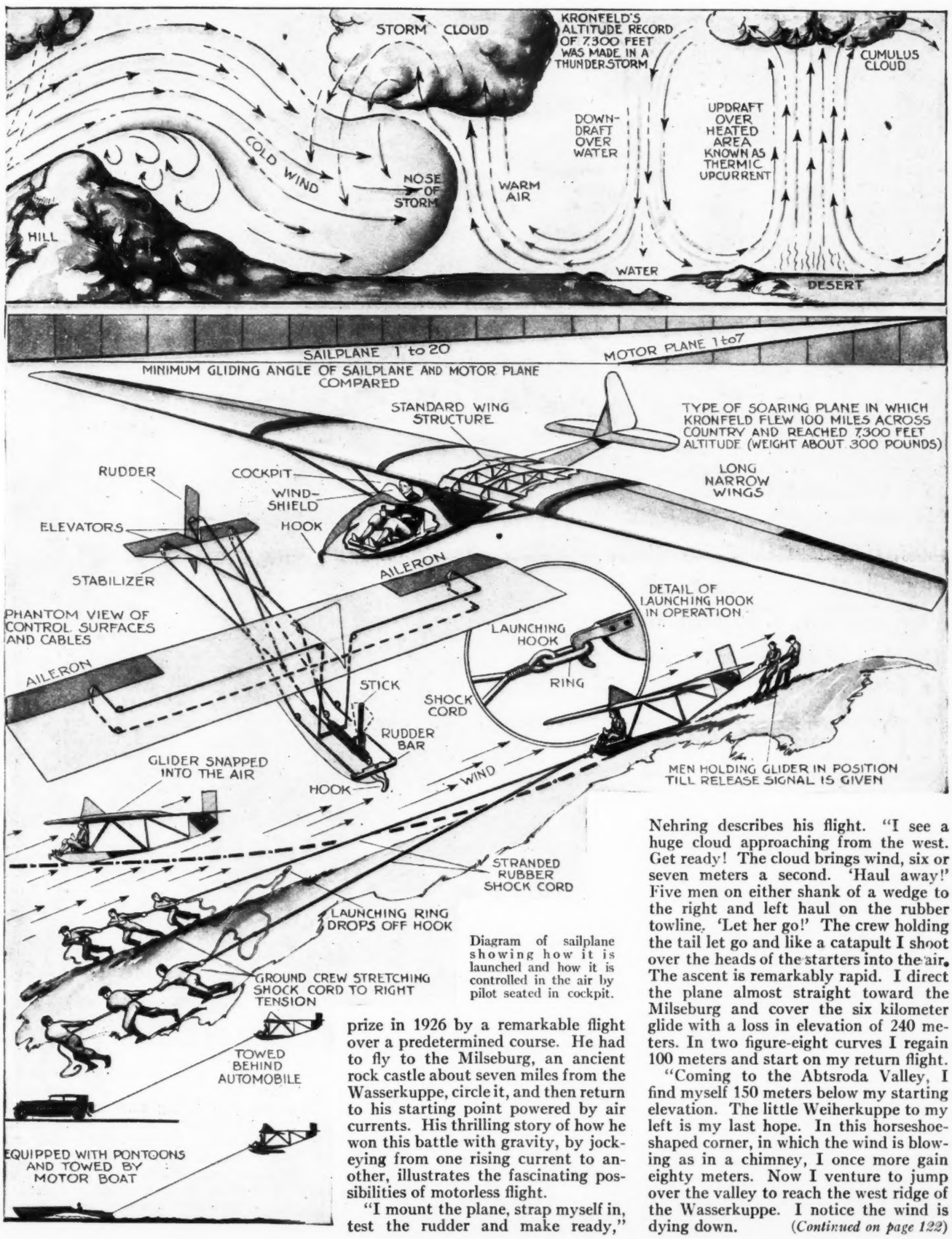


Diagram of sailplane showing how it is launched and how it is controlled in the air by pilot seated in cockpit.

prize in 1926 by a remarkable flight over a predetermined course. He had to fly to the Milseburg, an ancient rock castle about seven miles from the Wasserkuppe, circle it, and then return to his starting point powered by air currents. His thrilling story of how he won this battle with gravity, by jockeying from one rising current to another, illustrates the fascinating possibilities of motorless flight.

"I mount the plane, strap myself in, test the rudder and make ready," Nehring describes his flight. "I see a huge cloud approaching from the west. Get ready! The cloud brings wind, six or seven meters a second. 'Haul away!' Five men on either shank of a wedge to the right and left haul on the rubber towline. 'Let her go!' The crew holding the tail let go and like a catapult I shoot over the heads of the starters into the air. The ascent is remarkably rapid. I direct the plane almost straight toward the Milseburg and cover the six kilometer glide with a loss in elevation of 240 meters. In two figure-eight curves I regain 100 meters and start on my return flight.

"Coming to the Abtsroda Valley, I find myself 150 meters below my starting elevation. The little Weiherkuppe to my left is my last hope. In this horseshoe-shaped corner, in which the wind is blowing as in a chimney, I once more gain eighty meters. Now I venture to jump over the valley to reach the west ridge of the Wasserkuppe. I notice the wind is dying down.

(*Continued on page 122*)

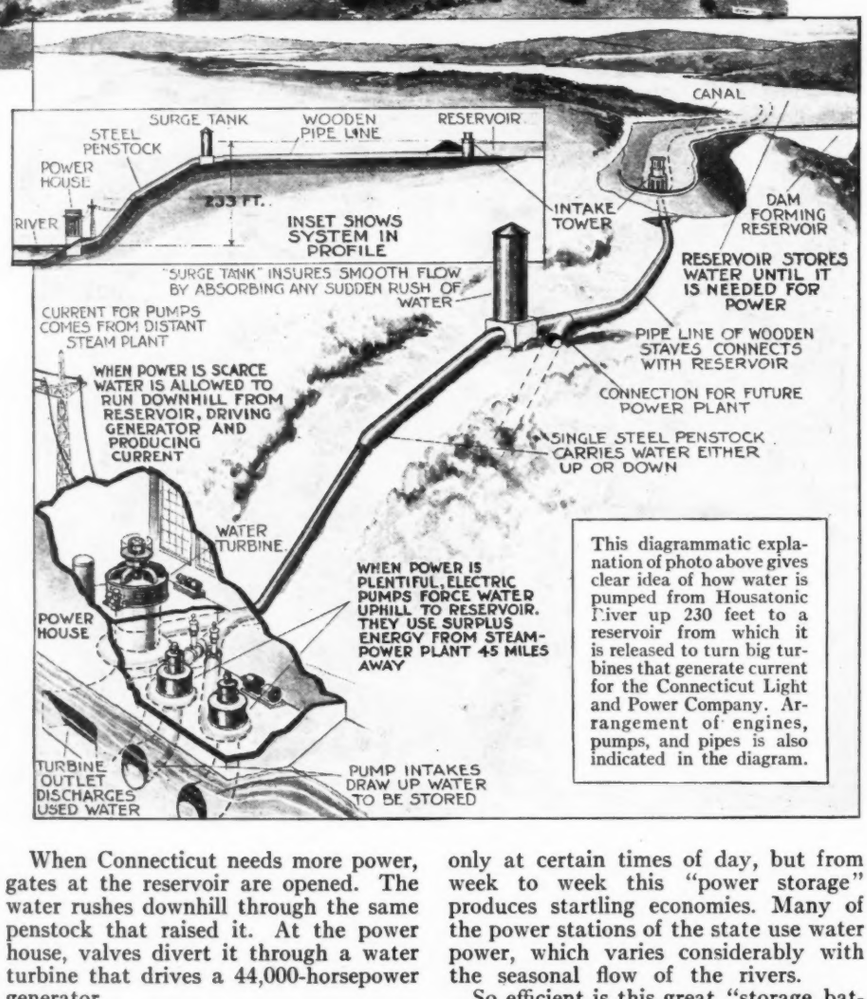
A Ten-Mile Storage Battery

Big reservoir takes load off electric company's engines. Only system of the kind in this country.

HOW to store reserve power for daily peak loads and seasonal shortage of water was a problem the Connecticut Electric Light and Power Company solved by erecting a unique plant near New Milford, Conn.—a sort of gigantic electric storage battery. By pumping water uphill and then letting it flow down again through a water turbine and generator, this power station can store more electricity than all the storage batteries of all the automobiles in the United States put together. It is the first large plant of its kind ever built in this country, although the idea has been applied successfully in Germany (P.S.M., Apr. '30, p. 50).

Surplus electricity from a steam-power plant at Devon, Conn., forty-five miles away, charges this giant storage battery by pumping water into a reservoir. When power is abundant, the Devon plant runs two 8,100-horsepower pumps that raise water from the Housatonic River, beside the power station, to the storage reservoir, 230 feet above.

A tapering pipe starts at the power house as an eleven-inch penstock and widens to a fifteen-foot conduit of wooden staves. Up this pipe line the water travels to fill the reservoir, ten miles long.


CANAL
SURGE TANK
WOODEN PIPE LINE
RESERVOIR
STEEL PENSTOCK
POWER HOUSE
RIVER
233 FT.
INSET SHOWS SYSTEM IN PROFILE
INTAKE TOWER
DAM FORMING RESERVOIR
RESERVOIR STORES WATER UNTIL IT IS NEEDED FOR POWER
"SURGE TANK" INSURES SMOOTH FLOW BY ABSORBING ANY SUDDEN RUSH OF WATER
CURRENT FOR PUMPS COMES FROM DISTANT STEAM PLANT
PIPE LINE OF WOODEN STAVES CONNECTS WITH RESERVOIR
WHEN POWER IS SCARCE WATER IS ALLOWED TO RUN DOWNHILL FROM RESERVOIR, DRIVING GENERATOR AND PRODUCING CURRENT
CONNECTION FOR FUTURE POWER PLANT
SINGLE STEEL PENSTOCK CARRIES WATER EITHER UP OR DOWN
WATER TURBINE
WHEN POWER IS PLENTIFUL, ELECTRIC PUMPS FORCE WATER UPHILL TO RESERVOIR. THEY USE SURPLUS ENERGY FROM STEAM-POWER PLANT 45 MILES AWAY
POWER HOUSE
TURBINE OUTLET DISCHARGES USED WATER
PUMP INTAKES DRAW UP WATER TO BE STORED

This diagrammatic explanation of photo above gives clear idea of how water is pumped from Housatonic River up 230 feet to a reservoir from which it is released to turn big turbines that generate current for the Connecticut Light and Power Company. Arrangement of engines, pumps, and pipes is also indicated in the diagram.

When Connecticut needs more power, gates at the reservoir are opened. The water rushes downhill through the same penstock that raised it. At the power house, valves divert it through a water turbine that drives a 44,000-horsepower generator.

Thus at "peak" hours, electricity from the dynamo is fed back into the power network that supplies the state. Not only at certain times of day, but from week to week this "power storage" produces startling economies. Many of the power stations of the state use water power, which varies considerably with the seasonal flow of the rivers.

So efficient is this great "storage battery" that it delivers sixty-one horsepower for every hundred horsepower that is used to pump water.

POPULAR SCIENCE SCRAPBOOK

News, pictures, and brief bits about unusual people, places, and things from all parts of the world are shown on the following pages.

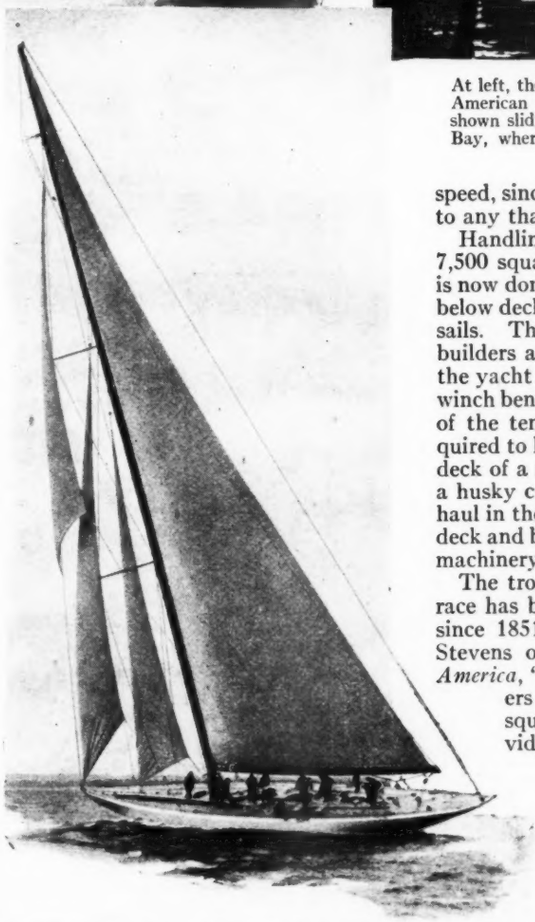
At left, the 168-foot hollow mast made for the American yacht *Enterprise*, which, above, is shown sliding down the ways at Narragansett Bay, where it may race *Shamrock V* next fall.

AMERICA'S CUP DEFENDER GETS 168-FOOT MAST

WHEN the pride of America's yachts meets the British challenger off Narragansett Bay, R. I., next September to decide whether the United States will retain the famous America's Cup, the contest promises to be a "Battle of the Masts."

First of the defenders to take the water, the 121-foot *Enterprise* has just been fitted with her enormous 168-foot mast. Three others, the *Whirlwind*, *Yankee*, and *Weetamoe*, have masts more than 160 feet high. From the four, the yacht will be chosen that will race the British challenger, Sir Thomas Lipton's *Shamrock V*, a photograph of which appears on the following page. This craft will use a 150-foot mast with a ten-foot topmast; the huge spar will arrive here on the deck of a steamship while the yacht itself will cross the Atlantic under a less spectacular, but more seaworthy, rig.

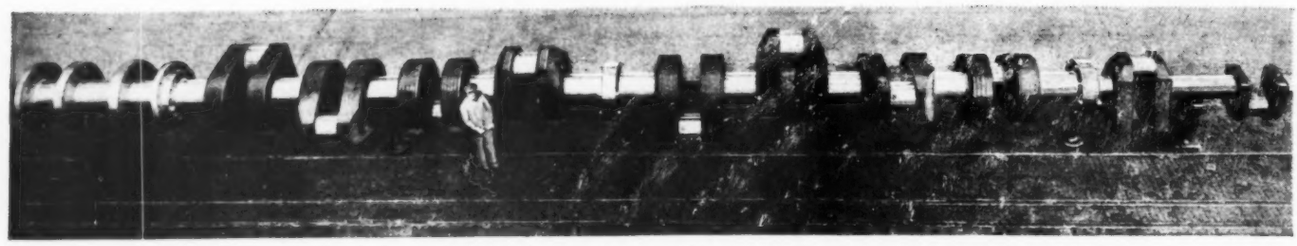
Veteran yachtsmen consider masts of this size revolutionary. Yet they and the sails they carry are declared to be the outcome of scientific study of wind action on sails and airplane wings. This year, for the first time in a race for the America's Cup, all of the racers have adopted the Marconi rig, in which a single narrow mainsail tapers from the boom to the tip of the mast. This replaces the gaff-headed lower sail, used together with a triangular topsail, which was formerly the conventional rig. The new type of sail, installed upon the giant masts, is expected to give the racers exceptional speed, since it is aerodynamically superior to any that has been used before.



The cup defender *Enterprise*, 121 feet long, under full sail. Note the Marconi rig, in which the mainsail tapers from boom to top of mast without a topsail.

Handling this great expanse of canvas, 7,500 square feet of it in the *Enterprise*, is now done by machinery. Power hoists, below deck, have been used before to raise sails. This year, however, the yacht-builders are going a step farther. While the yacht is traveling under sail, a power winch beneath the deck will take the place of the ten or a dozen men formerly required to handle the sheets. Hitherto the deck of a racing yacht was a place where a husky crew strained in a tug-of-war to haul in the boom. Now a mate stands on deck and barks orders down a hatch—and machinery does the work.

The trophy for which the yachts will race has been held by the United States since 1851, when a certain Commodore Stevens offered to race his yacht, the *America*, "against any number of schooners belonging to any of the yacht squadrons in the kingdom," provided there should be at least a six-knot breeze. The 101-foot *America* triumphed over seventeen crack racers of the Royal Yacht Squadron. Since that time forty-eight boats have competed for the trophy which this country still holds. In 1871 the present rule was adopted that makes the race between only two yachts.



The size of this gigantic crank shaft, which is fifty feet long and which weighs fifteen tons, can be judged from the comparative size of the man who is standing in front of it. The shaft, made in Germany, will be built into a motor ship and sent to Japan.

50-FOOT CRANK SHAFT BUILT IN GERMANY

A MONSTER crank shaft, that makes the ordinary automobile variety look like a part for a toy, has recently been made at a steel works in Dortmund, Germany.

Fifty feet long and fifteen tons in weight, it would require a gasoline engine operating a motor car as long as a city block to satisfy its driving capacity, according to the proportionate lengths of the crank shaft and body of an automobile of average size.

The giant shaft is to be built into the hold of a new ocean-going motor ship and then delivered to a customer in Japan.

$10,000,000 CRUISER IS NEW FLAGSHIP

ONLY the buoy-shaped framework of a rudimentary conning tower and a few heavy winches set about the gunwales would have hinted to visitors in the Mare Island Navy Yard, California, a short time ago, that the steel structure they saw raised on a scaffolding was a large cruiser nearing completion. She was the *Chicago*, now christened as the flagship of the United States cruiser fleet, and built at a cost of $10,000,000.

The *Chicago*, one of a series of sister ships, has a length of 570 feet, with a sixty-five foot beam. Turbine engines developing 107,000 horsepower, turning four shafts and four propellers to create a cruising speed of thirty-two and a half knots, comprise the power plant.

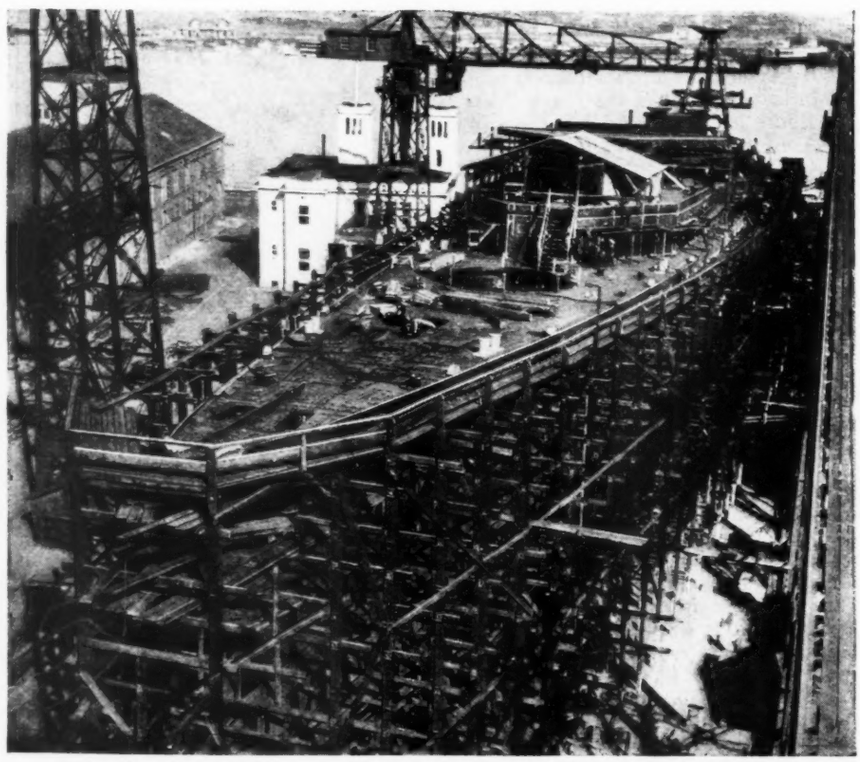
Typical of the unarmored scouts which the Government builds for cruiser service, the *Chicago* is a far cry from her ancestor of Civil War days, the *Wampanoag*. This was a 4,000-ton steam frigate that astounded the world by maintaining a speed of almost eighteen knots for twenty-four hours. Today the average cruiser in the Navy is able to run thirty-five to forty knots without difficulty.

LIPTON'S NEW *SHAMROCK* SMALL BUT MAY BE FAST

SIR THOMAS LIPTON'S yacht *Shamrock V*, British challenger in the America's Cup race to be held in September off Rhode Island, recently slid down the ways at her birthplace of Gosport, England. The photograph above shows her just after the launching, which occurred on the same day as that of the *Enterprise*, first of American cup defenders, described on the preceding page.

The *Shamrock V* is smaller than any of the four defense boats except the *Enterprise*. The deck measurement of the British aspirant is less than that of any other entry. Her overhanging ends are shorter, and she has less beam. Charles E. Nicholson, designer, is counting on her large sail spread to drive her at record speed. The *Shamrock V* will perform best, he believes, in light to moderate breezes rather than in a blow.

One of the noteworthy parts of the British challenger is her mast, a 152½-foot spar which is to be brought over here separately. It is hollow, being built of many pieces of silver spruce glued together, and probably weighs only three fifths as much as the solid staff of a typical yacht in the international twenty-four meter (approximately seventy-eight feet) class.



This is the way the *Chicago*, new flagship of the American cruiser fleet, looked while being built at the Mare Island Navy Yard, Calif. Finished, it will carry 25 officers, 300 men.

OLD MOSAIC ART ON NEW CHIMNEYS

THE ancient art of "mosaic"—that is, creating murals and floor pictures out of thousands of stone or glass chips—has been revived in the twentieth century. Believed to have originated with the Egyptians, the art reached its highest development in Greece and Rome. In 1840 mosaic work took a fresh start, and in Germany today it is a growing industry. Chemistry, expert draftsmanship, and various tile-making processes all play a part in the fashioning of a modern mosaic.

Glass, marble, or tile products may be used as the basis for the myriad tiny bricks of which the mosaic is made. The color variety used embraces almost all shades and tints, there being some 1,300 or 1,400 different tones adapted to the work. In the early days, the little tiles composing a picture were laid in place with painful precision. The modern method is less tedious. The artist's design is traced on paper laid out in great sheets on the floor. The bits of glass or tile are then glued to the paper, making the mosaic a movable unit. After this has been done it may be transferred to the wall or floor space intended for decoration.

Both metal and glass enamels are used for the mosaic tiles. Metal enamels are made by placing pieces of metal leaf (gold, silver, and others) on a glass base, running a film of glass over them, and fusing them in a furnace.

Thousands of mosaics are being set into this huge picture. The tiny colored tiles are now widely used for decorating buildings.

At left, a tall chimney set from top to bottom with thousands of mosaics done in the modern style. At right, fingers as deft as those of a surgeon are needed to fit the tiles perfectly.

GIRL ASKS CONGRESS TO PROTECT HER DESIGNS

DESIGNING footwear is just as worthy to rank among the arts as any other craft, maintains Mary E. Bendelari, of Paris and New York, who is one of the most prominent artisans in her sphere. Only twenty-seven years old, she has assumed the responsibility of placing before the members of Congress a resolution to permit the patenting of designs for footgear. The intricate geometrical patterns for adorning shoes and slippers made by those of her craft, this young designer feels, have as much right to be guarded against imitation as have the plans of the engineer or the inventions of the mechanic. She is seen below at work.

Mary E. Bendelari, of Paris and New York, has asked Congress for a law so that her original designs for footwear can be patented.

PARENT'S BLOOD ENDS MEASLES IN CHILD

PARENTS who are willing to give their children a little of their blood can not only cure them of measles but endow them with a lifelong immunity to the disease. This is the conclusion of Dr. Shirley Wynne, Commissioner of Health for New York City.

Injections of blood serum from convalescents of measles have been used to immunize infants and children against the disease. But this is a feeble source of serum at best. Dr. William H. Park, Director of the Laboratories of the New York Health Department, states that the use of parents' blood for immunization purposes is a solution of the problem.

FIND MILLION-YEAR-OLD TRACK OF GIANT BEAST

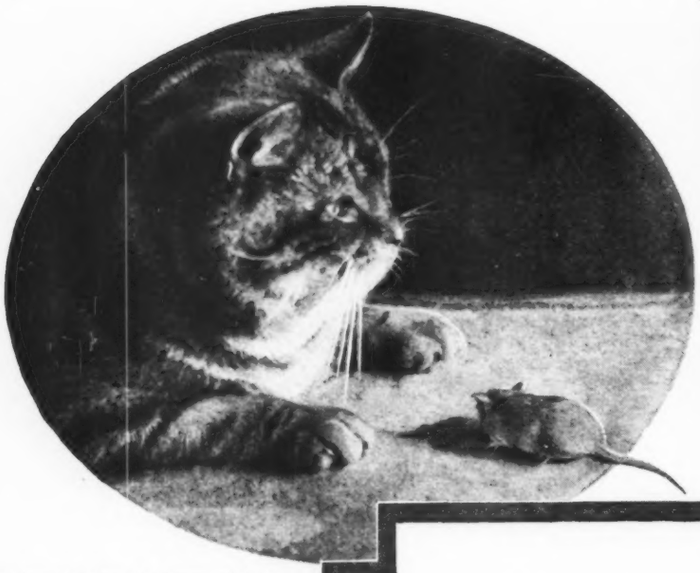
A MAMMOTH footprint for geological detectives to decipher has been found in a clay bed near Woodbridge, N. J. It may be anywhere from five million to fifty million years old, says Dr. Albert Orion Hayes, curator of the Rutgers University Museum, and probably belongs to a dinosaur of the Cretaceous period. If that is true, this lizard monster, who walked like a kangaroo, slipped in the clay bed and left his footprint for evidence somewhere around the time that most of the coal in the United States was being stamped by tremendous geological forces from early vegetation.

What may have happened, Dr. Hayes suggests, is that the dinosaur came lumbering across the clay bed at full tilt and struck an area of shallow water where his feet sank into the clay. Sand drifted in and covered the place with a protective layer fifteen feet deep, which has preserved the unique geological clue. The footprint measured twenty inches from toe to toe, and was as long as it was wide. It was about three inches deep.

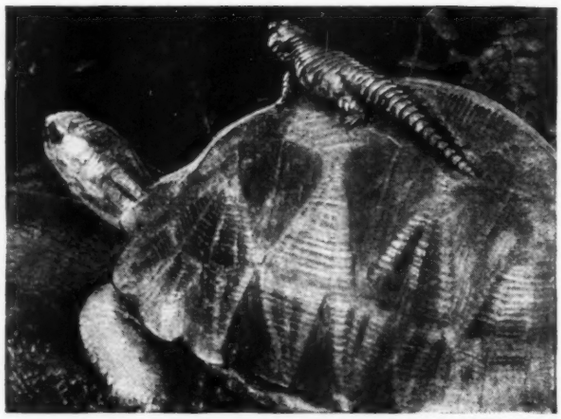
In order to transfer the precious clay document to the Rutgers Museum near by, where it could be permanently preserved, a block of earth a yard square containing the footprint was dug out. The top of the block was then sliced off with cutting wire and the clay plate thus made taken to the museum, where it was dried.

Dr. Barnum Brown, of the American Museum of Natural History, an authority on dinosaurs, said that this was the first dinosaur footprint of the Cretaceous period to be discovered in the eastern portion of the United States.

Strange Friendships Among Animals



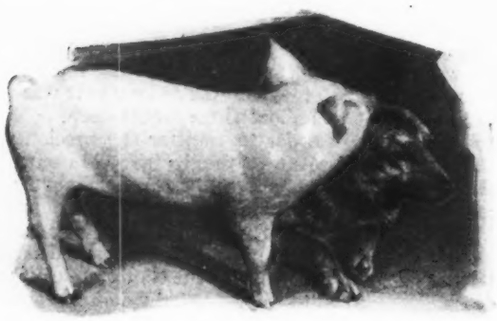
When the lion lies down with the lamb—or maybe this cat and mouse really are on friendly terms and Pussy has no idea of following her natural bent. It's a fact that surprising intimacies do spring up between animals born to be enemies and of course this may be a case of that kind. Still the mouse better watch his step and take no chances.



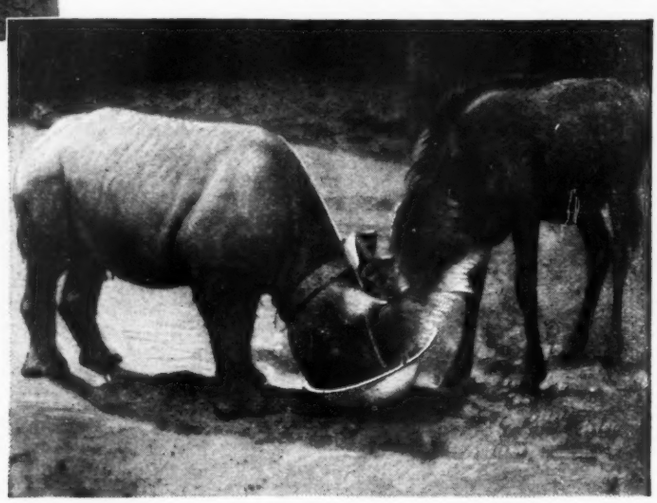
What's a chameleon, more or less, to a hard shelled old tortoise? If the little one is all tired out, and if speed is no object, he couldn't do better than make use of the big, lumbering turtle. At times animals do seem to have kindly feelings toward each other. Note the likeness in the heads.

Not at all like cats and dogs are these pets feeding. Each appears likely to get a fair share of food, including the lamb, though it's hard to say just how long the peace pact will last.

Here a matter of dividing a dinner with the chicks seems to find the cat undecided. It may amaze those not familiar with the ways of animals to see that the cat doesn't take the chickens in place of the milk, but it's a long time since kittie's ancestors stalked the jungle for food.



This dachshund has chummed up with a baby pig and the two have become inseparable in spite of the fact that for centuries dogs and pigs have hated each other for no apparent reason. These two, laying aside the age-old grudge, are setting the others an excellent example.



In general, instinct should make this rhinoceros hate the sight of an intruding deer, but this baby forgot its ancient animosity and consented to share its dinner with an enemy, though rhino obviously is occupying considerably more than half of the basin. It's likely that hunger drove these two together and that after digesting their meals they'll call off the truce and quarrel.

Just Like Their Ancestors

Age-old methods of work and cure still practiced by primitive tribes in spite of the wide use of mechanical marvels.

Natives of Ceylon continue to drill pearls in this ancient way. The method is so old that its origin is lost in the mists of antiquity, but no worker could be induced to discard it in favor of a more efficient, up-to-date process.

Driving out an evil spirit. An earache or a pain in the stomach is enough to make a native of Zululand, Africa, think he is possessed. Then the witch doctor gets busy in the old, old way.

This is not one of the pipes of Lucknow, but it is a silversmith of that city in India working at his trade in the same surroundings and with the same tools that were old in the Far East when northern Europe was still a wilderness.

This is a really progressive wood turner among the Uzbegs of the Caucasus Mountains. The tools he is using may seem primitive to you, but they are the latest thing to him in spite of the fact that they are exactly the same as were used by his great, great grandfather. The Uzbegs are reputed to be of ancient Turkish ancestry.

Probably this Russian woman, right, never heard of an electric washing machine or even of a washtub. She is doing her washing in the way her ancestors did it hundreds of years ago. A shallow tub, a pot, and a fire can, with the baby near at hand, are all that she needs for a big day.

PULPIT SERVES AS TOOL BOX

A UNIQUE pulpit that plays a dual role, either as a Bible rest or preaching desk for religious services, or as a tool cabinet, has recently been designed by Captain Charles Stratford of the Salvation Army in Washington, D. C.

The pulpit opens at the back and reveals a tool box equipped with all the implements needed to carry on a course in manual training and carpentry. Stratford conducts classes in wood carving.

PROPOSED NEW CALENDAR IS 4,000 YEARS OLD

THOSE who propose a revised calendar are four thousand years behind time, according to Professor Arthur Posnansky, a German authority on obscure civilizations of the ancient world.

On a broad plateau touching the boundary line between Peru and Bolivia and overlooking Titicaca, the largest lake in South America, there lived, four thousand or more years ago, a mysterious people who raised enormous temples and adjusted their lives to a calendar of twelve months divided into three ten-day weeks. The actual calendar as written by the savant priests of the ancient race has been discovered by Professor Posnansky, who is in Bolivia exploring the relics of the Tiahuanacans.

The odd days of the year were apparently devoted to holidays or sun worship, the professor says, and the calendar was far more practical than that of the present day.

Although the Tiahuanacans are believed to have flourished at the same time as the Egyptians, it is difficult to trace their history, since they are unknown to contemporary Peruvians. The colossal stone structures built by the strange race are filled with huge monuments and statues, and enhanced by elaborately carved doorways. The remains are considered in many respects to be among the most interesting of archeological records discovered in America.

GERMAN PUBLIC GETS ART WORKS CHEAP

LOVERS of the archeological treasures of the past may now have these relics as household ornaments in Berlin, Germany. In the great Berlin Museum, a special department has been set aside in which sculptors devote their time exclusively to modeling in plaster reproductions of ancient pieces of sculpture, stonework, domestic implements, and various other reminders of bygone civilizations. Heads of Egyptian Pharaohs, Roman busts, Greek statues, or Etruscan vases are typical of the ancient objects that are faithfully reproduced.

German sculptor making a copy of the head of Queen Nefretete, mother-in-law of the Egyptian King Tut. Colors are reproduced.

Being modeled in cheap compositions such as plaster or clay, they can be offered to the public at prices so low that even the poorest can afford to have them. In the name of art, many famous and popular German sculptors have offered their services to the Museum free of charge in order that the poorer classes of their countrymen may have these art objects to decorate their homes with.

EIGHT-FOOT GRAF ZEP FLIES 1,800 MILES

A MODEL-MAKING enthusiast of Toronto, Canada, recently built an eight-foot reproduction of the *Graf Zeppelin*, filled it with gas, put a note in it asking the finder to communicate with him, and launched it. Watching it disappear over the trees, his friends told him he would never hear of it again, that he would have nothing to show for his pains. Many days later a note came from a trapper, camped near Fernie, British Columbia. He had picked up the model dirigible after it had traveled approximately 1,800 miles.

PARIS CONCERT HALL HAS GIANT PIPE ORGAN

MUSIC from 4,800 pipes filled the huge Salle Pleyel, a Paris concert hall, recently, when a new giant organ was put into use. With its seventy-one stops, it is not the greatest organ in France, for that of the Saint-Sulpice Church in Paris has one hundred and that of the Notre Dame Cathedral eighty-six, but it is believed to be the largest organ ever placed in a concert hall.

Built by the famous house of Cavaillé-Coll, the organ's mechanism is electro-pneumatic. Its concealed machinery is controlled by 750 wires contained in one cable connecting the instrument with a chamber under the stage. These wires have a combined length of 182 kilometers, or almost 113 miles. Each stop and register is provided with an automatic signal light that flashes on when a stop or register is used, to facilitate the work of the organist who is seated at the console in the darkened auditorium.

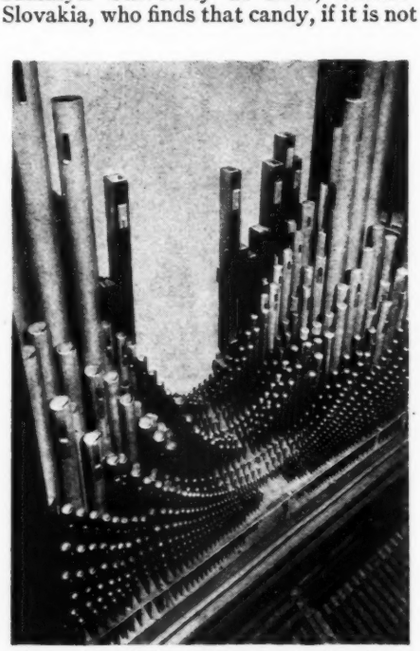
STATIC FORECASTS MAY HELP RADIO FANS

OLD MAN STATIC, bane of radio fans, may soon be prophesied just as the weather is. Daily reports of magnetic disturbances would tell the listener what sort of radio reception to expect for a coming period.

This is the proposal to be offered at the forthcoming meeting at Stockholm, in August, of the International Geodetic Survey's section on earth magnetism and electricity. According to the plan suggested, reports of daily magnetic storms, which are frequent offenders as static producers, would be broadcast at the same time as the usual weather reports.

SUNLIGHT KEEPS CANDY FREE FROM GERMS

CANDY needs sunlight and fresh air to keep free of disease germs, just as human beings do. The new transparent wrappers for candy, made of paper treated with certain chemicals, act like good windows in a home, letting in light and keeping candy healthy. This statement is contained in an announcement by Prof. K. Driml, of the Institute of Hygiene of Masaryk University at Brno, Czecho-Slovakia, who finds that candy, if it is not



Just a few of the 4,800 pipes in the giant organ now being used in a Paris concert hall.

to be a germ-carrying menace, must remain dry.

Tin foil and other metallic coverings which shut out light and air from the candy, he says, may sometimes provide a happy hunting ground for microbes, who love to stay where it is dark and damp. Snug and moist under a protective tent of tin foil, they may live indefinitely. But where things are thoroughly dry, the professor says, the germs disappear, dying off rapidly.

This does not mean that loose candy lying about without covering of any sort is necessarily uncontaminated. It may pick up more germs from being constantly handled than protected candy breeds inside the wrappers. The best immunity against germs, the professor finds, is that afforded by the transparent wrapper.

TEST HIGH POWER RADIO

WHEN the experimental radio station W2XAG, at Schenectady, N. Y., came roaring in on receivers from Alaska to Hawaii recently, radio listeners had a chance to hear the most powerful broadcasting station ever operated in the United States. It used 200 kilowatts of power. This is enough to light 2,000 household electric lamp bulbs of the large hundred-watt size. A special license from the Federal Radio Commission authorized the test, which was made by the General Electric Company.

SOUND FILM IS USED TO RECORD CONTRACT

SIGNING contracts by word of mouth will be just as binding as signing them "on the dotted line" hereafter if the world of business adopts the "talkie" method of affixing signatures.

A permanent sound film contract was recorded the other day when Mary Lewis, opera star, was engaged to appear in talking pictures. The oral offer and acceptance were stamped on the celluloid film in picture and synchronized sound.

Mary Lewis (center), well-known operatic singer, "signs" a contract to appear in a talking picture, the contract being recorded by sound film.

6,000,000 CANDLEPOWER MOVIE LIGHT

THE newest and biggest "star" in the firmament of the movie world is a gigantic incandescent light, developed in the research laboratory of the General Electric Company to help solve some of the difficulties that are raised by the latest requirements of the moving picture industry.

The complete light includes a vehicular tripod bearing a reflector with a socket at its base in which fits the huge bulb. This bulb is three feet in diameter and is capable of 6,000,000 candlepower. It has sufficient tungsten in its coiled filament for 126,000 ordinary electric lights.

This light is typical of the changes in movie illumination since the "Kleig" lights were found unsuited to the talkies. "Kleig" lights work with a buzzing that interferes with the recording of talking film.

It takes two to hold this 6,000,000-candlepower bulb, world's largest incandescent light, made for the talkies.

WHY GOLD RINGS STAIN THE SKIN

THE black marks left by gold jewelry on the necks and wrists of women are the chemical price that must be paid for an enduring variety of this precious metal.

Such, in essence, was the explanation recently given by the editorial staff of the American Medical Association. Pure gold is so soft that it could hardly retain its shape as bracelets or necklaces, and certainly it could not for any length of time stand the wear and tear of constant use as jewelry. Goldsmiths therefore are obliged to mix alloys with the metal to give it qualities of hardness and endurance. What is known as eighteen-karat gold, for instance, contains only seventy-five percent of pure gold, while the rest of it consists of other metals, such as silver or copper.

These alloys develop certain "sulphides" as a result of chemical reaction between the metal and slight amounts of sulphur which may be in the atmosphere or in the perspiration of the skin. It is the black sulphides, the report said, which are responsible for the marks left on the skin by gold jewelry. On some skins the stains do not form, as the chemical composition of perspiration differs, some persons secreting much more sulphur from their skins than others.

ULTRA-VIOLET LAMPS MAY ABOLISH WINDOWS

CITIES composed of windowless houses, whose inmates live independently of the sun and the weather, creating their own sunlight and ventilation, are foreseen by Dr. Zay Jeffries, a metallurgist of Cleveland, Ohio. By substituting for the sun lamps yielding ultra-violet rays, which are believed to stimulate the bodily processes and increase the number of red cells in the blood, people could thus do away with the necessity of windows and at the same time live in a healthy environment. Artificial ventilation could be arranged. The elimination of windows, Dr. Jeffries said, would have many advantages and lead to radical changes in house design.

TOM THUMB OPOSSUM FOUND IN ARGENTINA

TOM THUMBS are found among animals as well as among men. If on a walk across the fields some time you should happen to encounter a tiny quadruped one half tail and the other half mouse, look at it carefully, for it may be a "muscula," or the world's smallest opossum.

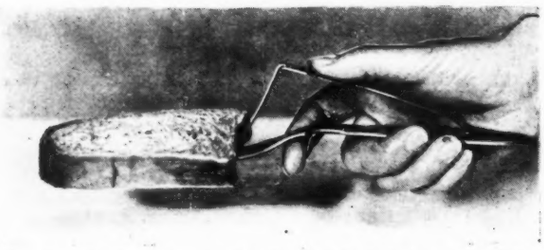
The diminutive tail acrobat (opossums rival monkeys at feats with their tails), recently described by H. Harold Shamel of the United States National Museum, is less than five inches from the tip of his nose to the end of his tail.

But there is small chance of meeting the queer little fellow anywhere in the United States, because so far as is known, he is found only in Argentina.

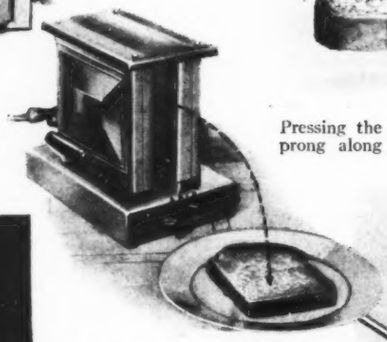
Silk stockings and other fragile clothing not meant for the regular wash go into a separate compartment in this metal hamper. Soiled clothes are all put in at the top but only the heavy articles come out at the bottom.

When this electric cooker is placed face downward over a plate of meat, radiant heat cooks it through in ten minutes. In this way, meals can be prepared at the table.

Inventions to Lighten Your Household Chores



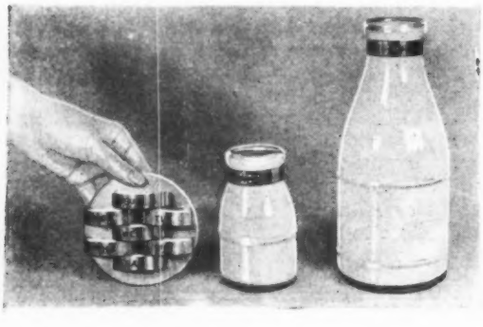
Pressing the lever on the handle of this fork forces a sliding prong along the tines and frees them from toast or meat.



This automatic toaster not only turns off the heat as soon as bread is toasted, but it also shoots the slice out onto a convenient plate. It can be readily adjusted to give light, medium, or well browned toast according to user's preference.

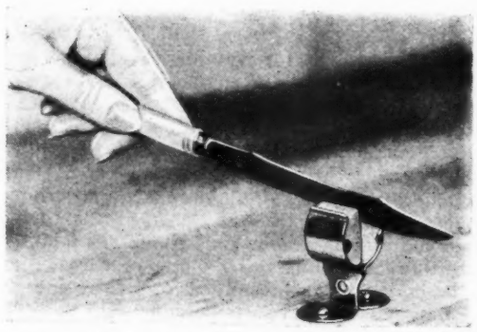
Drip coffee, a cup at a time, can be made with this device which fits any standard sized cup.

Just put your mop in this dust cleaner, close the lid, twirl the mop a few times, and the dust is all gone. To empty the container, turn it upside down so the dust can collect in the cover. It's then easy to take that off and empty it into the ash barrel.



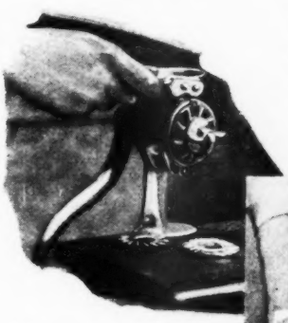
Now which bottle contains the fresh milk? You will have no trouble answering that question if one of these tags is slipped around the neck of the bottle as soon as it arrives. There's a label for each day in the week; an aluminum disk holds them when not in use.

A whole three-course dinner can be cooked at once in twenty minutes in this utensil. Pressure speeds up the process and only one gas burner need be used.

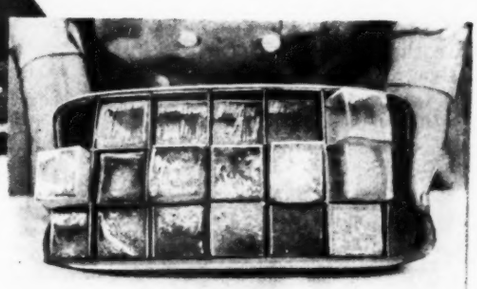


This unobtrusive device, which fastens to wall or table, has two stones against which a knife is sharpened.

The toothed ridge on this dustpan is credited with taking lint out of the broom and gathering up the last trace of dust that ordinarily clings to the floor. A handle for the toe gives the sweeper a chance to hold the pan firmly in place without stooping.



This meat chopper gives you what you want—coarse, medium, fine, or extra fine. It can be fastened to even a narrow table ledge. One turn of the wrist opens it wide, making it easy to clean.

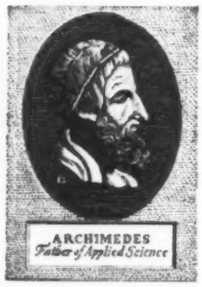


Ice cubes can't stick in this flexible tray, which is made of rubber instead of metal. Just spring back the sides and the ice is released without prodding.

Ordinarily this combination piece looks like a stool but when rods, which disappear through holes in the top, are drawn out it becomes a clothes rack, saving you steps on ironing day.

At right, a spoon that is more than a spoon. It has on the bowl rough projections that make it a grater. Also there is a forklike tine on one side that proves useful in lifting meats or in freeing food that sticks to bottom of frying pan.

Popular Science MONTHLY



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The Price of Beefsteak

THERE is a very definite connection between the pile of unused gold in the Sub-Treasury vault and the price of beefsteak. Gold is the standard of value. The price of a pound of gold dust in United States dollars is now exactly what it was when the first dollars were coined in the United States Mint. But a dollar bill or its equivalent in gold dust will buy considerably less beefsteak or any other commodity than it did years ago.

Mass production has helped to keep the value of the dollar low in the face of a dwindling gold supply. A shortage of gold will make the dollar much more valuable, however, as is pointed out in the article on page 41. With any serious shortage will come an era of lower wages and falling prices. The world would then see the rich become richer and the poor poorer with a consequent increase in poverty and want. That is because the interest on fixed investments, such as bonds and mortgages, also is fixed in dollars.

Of course, over a long period of years, the situation would straighten itself out, but it is to be hoped that the aid of science will so augment the harvest of gold as to prevent any such calamity.

We Must Have Fireworks

LOCAL ordinances, in many cities and towns, ban the sale of fireworks. Such measures are taken in the belief that they reduce the accidents that mar each Fourth of July celebration.

Unfortunately, the lovers of fireworks must suffer from the carelessness of the few who ignore the ordinary rules of safety.

POPULAR SCIENCE MONTHLY, while backing to the utmost any measure that may reduce accidents, regrets the necessity for such precautions. Familiarity with fireworks is the first step in preventing accidents due to ignorance. On page 38 of this issue, an article describes how fireworks are made. Such constructive information, we believe, often proves more effective in reducing accidents than prohibitory ordinances which may or may not be obeyed.

There are sound reasons for opposing the wholesale abolition of fireworks. In the truest sense of the word, makers of fireworks constitute an "essential industry." The plants that make Fourth of July devices turn out fusees for railroad safety and life-saving distress rockets for ships. Their factories helped win the World War, when they were completely turned over to make signals and flares for our troops. Today, our Government does all in its power to encourage the makers of fireworks.

Putting Bunk in News

THE big job of any magazine or newspaper is to give its readers information, interestingly presented. If it fails in this the publication will soon lose all its readers.

Accuracy, obviously a basic requirement, unfortunately is not always given due consideration. Most publications avoid deliberate misstatements, but may handle the truth in such a slipshod fashion that the reader is sadly misled if not actually deceived.

A short time ago, for example, a new type of radio tube was introduced by a certain manufacturer. One publication ran an article which led its readers to believe that the new tube would revolutionize the radio industry and make all present sets obsolete. As a matter of fact, the tube does present technical possibilities which may result, after the engineers have had time to develop them, in some slight improvement which, by no stretch of the imagination, can be classed as revolutionary.

Recently the Bell Laboratories demonstrated a type of two-way television. This experiment is described on page 22.

A certain newspaper headlined its report of this feat with "Television Here." That, we submit, is misleading, because even the engineers in charge of the work stated that no new developments were involved nor could they see any way by which their laboratory experiment could be put to practical use either now or in the future.

Take a Backward Look

THE temporarily baffled and consequently discouraged worker in any field of scientific progress should, now and then, spend a few moments looking backward instead of forward.

Twenty-five years ago, for example, two unknown men with little money and practically no engineering training were trying to solve a problem that for ages had baffled scientists. A problem so difficult, indeed, that one learned scientist had publicly given it up as impossible of solution. Yet the Wright brothers succeeded in giving the world wings with which to annihilate distance, revolutionize warfare, and make hundreds of millions of people air-minded!

Another young man, about that time, was fiddling around with glass tubes containing tiny pieces of wire. Most of his friends considered him a bit addled for attempting something that common sense said was impossible. However, DeForest kept at it till he produced the radio vacuum tube, thus opening the door to broadcasting, which has influenced the daily habits of practically everybody.

Still another not so young man of twenty-five years ago was dreaming of a way to take a toy of the rich and turn it into something useful and practical. The idea was laughed at as a foolish pipe-dream, but the scoffers' smiles of derision didn't worry Henry Ford, who at last put the world on wheels and made himself one of the richest men in the country.

These three inventions, the airplane, the mass-production auto, and radio broadcasting, have had a powerful effect on your life and mine. Who can say how powerfully they will influence the trend of all civilization?

Make Your Glands Behave

MICROSCOPES, test tubes, sharp knives, and patience may remake mankind. That is, when a good deal more is learned about the ductless glands.

These little fellows are hidden away in the body, doing a secret job in a highly mysterious way. Until just recently, most of them were unknown to physiologists. Of course, the thyroid was known because goiter is nothing new in the world.

Then the evidence piled up to prove that the pituitary had something to do with growth; that the thymus controlled adolescence and practically disappeared after that period; that an unhealthy thyroid meant a flighty and uncertain mind; that improperly functioning sex glands led to perversion and degeneracy.

Now even more responsibility is being thrown on the glands. As told on page 19 of this issue, it appears they are the criminal makers. If your glands are right, you're probably honest; if they aren't, you have a fine chance of being a crook. If you are a crook, there's about a seventy-five percent chance that medicine and the surgeon's knife can make you honest by forcing your glands to behave themselves.

New Ways to Cure Radio Fading

How automatic control keeps volume at constant level. Two circuits for the experimenter

By ALFRED P. LANE

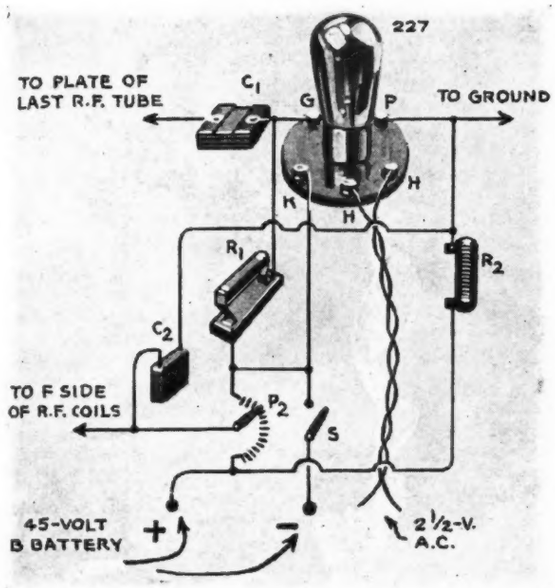


Fig. 1. A simple circuit for the automatic control. This should be applied only to a set with three or more amplification stages.

AUTOMATIC volume control, a feature of some of the latest radio receivers, is an interesting development. It offers virtually the only cure for fading that seems to promise any worth while results.

Of course, some form of volume control is necessary on any multi-tube radio receiver to adjust the power or amplification to fit the strength of the incoming signal. It is like the throttle on an automobile which regulates the power to suit the driver's speed requirements under various road conditions.

The automatic volume control on a radio receiver is, in effect, much like an automatic governor on an automobile. The automatic governor starts to close the throttle and thus cut off power from the motor when a predetermined speed is reached. The automatic volume control on a radio receiver cuts down the radio-frequency amplification—or, in other words, the power of the circuit—when the signal reaches a predetermined volume.

If you started an automobile fitted with a governor over a route of level stretches and hills the car would pick up speed until it reached the predetermined maximum. Then when it struck a hill it would begin to slow down and the automatic governor would immediately open up the throttle and the motor would develop more power to hold the speed practically constant. When the car passed over the top of the hill and started to coast down the other side it would tend to go faster and the automatic governor would again shut off the power.

RADIO signals received from distant stations often do not come in steadily at a given strength. The intensity of the signals varies between wide limits, and if the hand volume control on the set, for example, is adjusted so that the volume is satisfactory while the signal is quite strong, when the signal becomes weaker the sound will fade away and in some cases completely disappear. If such a set were fitted with an automatic volume control it would maintain a relatively steady level of volume from the loudspeaker.

Of course, the automatic volume control could work only within certain definite limits. If the signal faded out completely so that it was beyond the range of the receiver, silence would result regardless of whether the set were fitted with a hand volume control or an automatic volume control. In a way this parallels what would occur if an automobile fitted with a governor encountered a hill too steep for the motor to climb. The car would stop anyhow.

WHILE automatic volume control results in almost uniform volume from all local stations, it is of relatively little importance as far as local stations are concerned because these do not fade and the hand volume control once set for a given program need not be touched until a station is tuned out and some other station brought in.

AUTOMATIC volume control also produces a peculiar effect on the tuning of local stations. It appears to make the receiver tune broadly. Instead of the usual sharp peak or extra loud spot which can be found at one point on the dial, the volume may, on loud stations, appear to remain practically constant over several degrees.

The automatic volume control portion of the radio circuit can be worked out in several different ways; in most cases an extra vacuum tube is used and its function is to control the C bias of the radio-frequency stages, and the change in C bias, of course, changes the amplification of these stages. The circuit is always arranged so that the intensity of the incoming signal governs the plate current flowing through the regulator tube, and in A. C. type sets the plate current of the regulator tube is forced to flow through a resistance and, of course, the voltage developed at the terminals of this resistance will vary in proportion to the amount of plate current flow. This varying voltage is applied to the grid of the radio-frequency tube as bias.

It is difficult to apply this arrangement to a radio receiver already built because it would necessitate extensive changes in the wiring and perhaps even some mechanical changes to get the various biasing resistances grounded at the proper point.

For the benefit of radio amateurs who wish to experiment with automatic volume control two special circuits have been worked out in the Popular Science Institute radio laboratory. One is designed to use a 227 tube and the other uses a 201A tube.

The 227-tube circuit is shown in Figure 1. In this circuit C1 is a

(*Continued on page 125*)

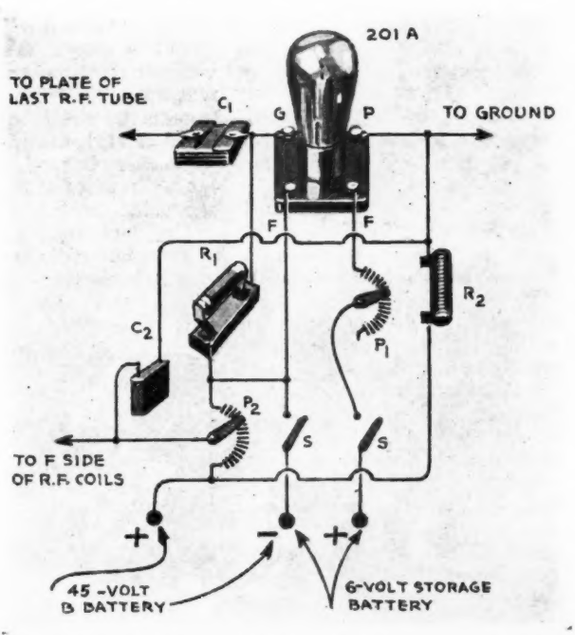
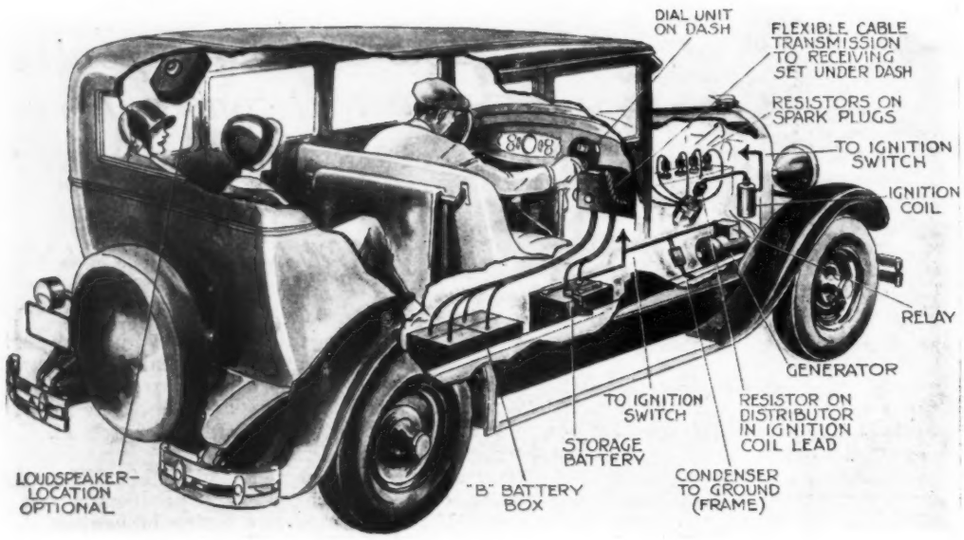


Fig. 2. In this battery operated control unit, separate A and B batteries must be used. Note an extra switch is also needed.

Putting a Radio in Your Car



This shows you exactly how a radio outfit can be installed in an automobile.

Need for high sensitivity bars cheap sets from autos. Interference caused by spark plugs and brushes can be overcome by the introduction of 25,000-ohm fixed resistor in each high tension wire. Car battery will supply current for A circuit but B battery must be installed.

By

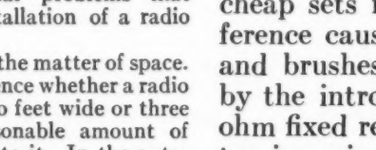
JOHN CARR

RADIO reception in an automobile presents many special problems that do not affect the installation of a radio set in your home.

There is, first of all, the matter of space. It makes no real difference whether a radio set for the home is two feet wide or three feet wide. Any reasonable amount of space can be devoted to it. In the automobile, however, inches count; and almost the only space not needed for other purposes is under the cowl, back of the instrument panel.

Commercial sets designed to fit in this space are now being manufactured by a number of different concerns, and because the space is restricted, as well as being of an irregular shape, many of the automobile radio sets are designed for flexible shaft control.

The receiver itself is built into a compact cabinet which can be fitted wherever the space will permit underneath the cowl and then connected by means of a flexible shaft to a small control panel mounted on the instrument board. In such sets the knob used to tune the set operates the variable condensers in the receiving unit by a flexible shaft.



Resistor designed to suppress interference caused by high tension wire in the auto.

Automobile radio installation differs from that in the home in a number of other important ways. The automobile radio must be very sensitive and consequently it is not possible to build one inexpensively. A cheap set would not be sufficiently sensitive to bring in adequate signals with what practically amounts to a short indoor antenna hidden in the top of the car.

An automobile radio must of necessity be battery operated, because there is no wall socket to supply current. However, part of the battery current required to operate the radio set is available in any modern car. The battery used for starting and lighting can supply current for the A circuit of the set. The high voltage direct current must be obtained from a set of B batteries carried in a special battery box, which can be attached at any convenient point.

The fact that the automobile radio set must necessarily be battery operated does not, however, mean that such a set is restricted to the use of the ordinary 201A battery type tube. In some of the commercially built automobile radio sets the UY-224 A.C. screen grid tube is used in the radio-frequency and detector circuits. This tube, of course, is a powerful radio-frequency amplifier and supplies the necessary sensitivity.

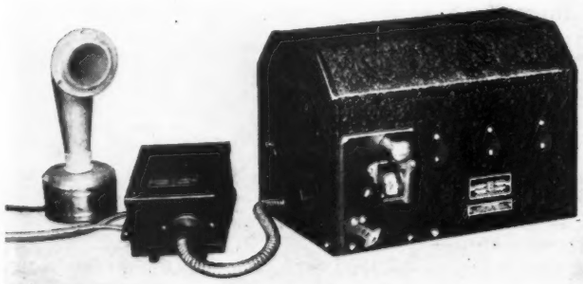
The standard practice seems to be to operate the heaters of two 224 tubes in series, and one typical set uses four 224 tubes and one 112A tube. In this particular circuit two pairs of 224 tubes are operated in series and the 112A tube is, of course, operated in the usual manner. The heater filament voltage for the 224 tube should be two and one half volts, so that two of them in series require five volts, a suitable load for a six-volt storage battery if a fixed resistance is used. Such a set would draw from the battery as much current as do the two headlight bulbs on the car. Other types of sets use 201A tubes in all sockets except the last or power stage, in which a 112A tube is used.

Suppressing the interference caused by the ignition system and electrical equipment of the automobile is necessary for good radio reception in the car.

The principal source of interference is the high tension wiring. Each spark produced at a spark plug induces in the high tension wiring high frequency oscillations which are radiated from the high tension wiring to the antenna in the roof of the car, and these are reproduced by the loudspeaker as a steady string of annoying clicks.

It has been found that the introduction of a 25,000-ohm fixed resistor in each high tension wire directly at the spark plug with another resistor located in the high tension lead from the spark coil to the distributor will suppress these high frequency oscillations.

(*Continued on page 135*)



A radio set built to go back of the instrument panel in an automobile. Note the loudspeaker, which can be moved to any part of the car.

HELPFUL HINTS FOR RADIO FANS

How Tuned Stages Are Cut Out

Untuned Radio-Frequency Transformer, Hooked with Screen Grid Tubes, Will Give Good Results

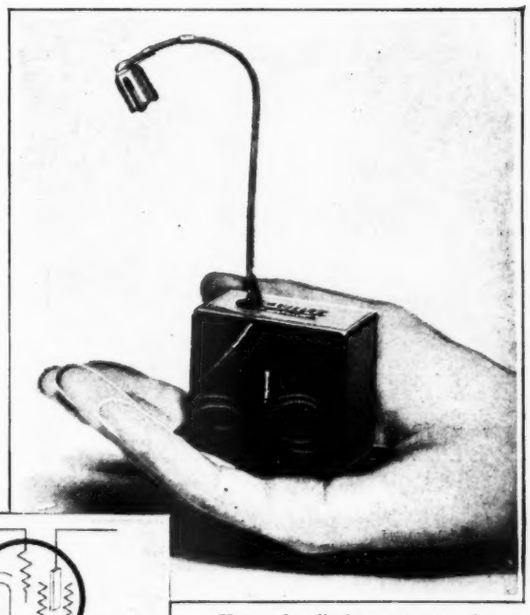
IN THE early days of radio broadcasting many radio sets were produced with the radio-frequency amplification obtained through the use of untuned transformers instead of tuning coils and condensers. The same idea is being revised for certain special uses with screen grid tubes.

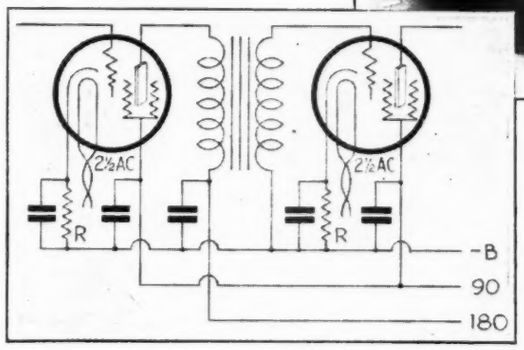
The illustration shows a new untuned radio-frequency transformer designed especially for use with screen grid tubes. When properly connected between the screen grid tubes, an amplification of about ten per stage is possible. This is, of course, lower than the amplification obtainable from tuned stages, which may run from twenty to thirty. However, the untuned circuit is much simpler and in many cases more stable. The diagram shows the circuit arrangement with four untuned radio-frequency stages using screen grid tubes.

It must be remembered that obtaining sufficient radio-frequency amplification is not the only problem. Selectivity also is necessary, and selectivity can be obtained only by tuned stages. Consequently, if a radio-frequency amplifier is built up from untuned stages it must be connected to some sort of pre-selector circuit such as was described in P.S.M., May '30, p. 71.

These special transformers are useful only with screen grid tubes. Their characteristics are such that they cannot be used between ordinary battery or heater type A. C. tubes. In the circuit shown the resistances labeled *R* should have a value of 750 ohms for each tube, and the condensers shown should have a value of not less than one fourth microfarad.

This untuned transformer for screen grid tubes may prove interesting to experimenters constructing portable receivers. The selectivity requirements of such outfits usually are not so severe as for sets to be used in the home. Furthermore, many portable sets are operated from a loop or a short antenna. The use of a loop requires high radio-frequency amplification which can easily be obtained by the use of three or even four stages of untuned screen grid amplification using these new transformers for coupling.





Untuned radio-frequency transformer for use with screen grid tubes. At the left, the circuit for this hook-up.

A B C's of Radio

THE maximum capacity of a variable condenser is determined by the area of the plates, the number of plates, and the spacing. The number of plates alone is no indication of variable condenser capacity. While manufacturers ordinarily make .0005 mfd. condensers with twenty-one to twenty-three plates, the same capacity could be obtained with half the number of plates by using larger plates or by setting them closer together.

The capacity of any variable condenser can be reduced easily by removing some of the fixed plates, and the reduction in capacity will be proportional to the number of plates that have been removed.

SMALL WIRE ANTENNA GOOD AS BIG

MOST radio beginners do not realize that the diameter of antenna wire has practically no effect on its ability to bring in stations. For example, with an antenna consisting of thirty feet of wire strung around the picture molding there would be no practical difference in results whether the wire be a heavy size such as No. 12 or a fine wire such as No. 22.

Furthermore, the insulation on an indoor antenna is of practically no importance provided the wire does not make contact with metallic lighting fixtures and passes only over dry wall surfaces.

The fact that small wire will give as good results as large wire makes it entirely practical to hide the indoor antenna so perfectly that it cannot be seen.

Number 26 single or double cotton covered wire is ideal for concealed indoor antennas. The wire can be run from the radio set along the baseboard to the corner of the room and thence up to the picture molding. The wire along the floor can be painted with floor varnish so that it corresponds in color with the floor, and the same kind of color and finish used on the wall can be applied to the wire that leads up the wall. Instead of using tacks to hold the wire in place, it can be attached at points a few inches apart by tiny drops of glue so that there will be no ugly tack-heads showing in the corner of the wall.

SIMPLE RADIO SET

IN THESE days of elaborate multi-tube radio receivers fitted with loudspeakers, etc., it is well to remember that far simpler sets will meet the broadcast reception requirements of a certain class of radio listeners.

If, for example, you live within a mile or two of a powerful broadcasting station and are willing to restrict your radio entertainment to the output of this station and use headphones, a simple crystal detector radio set will meet your needs. It is only when loudspeaker reception and selectivity are important that the receiving equipment must be elaborate.

You Can't Save Gas with Gadgets

"When you don't need any extra air," Gus explained, "there's lots of pull. But when you open the throttle, the pressure goes right down."

Better to Adjust Car's Carburetor Than Fool with Useless Devices, Says Gus

By MARTIN BUNN

"THIS looks pretty good to me," said John Southby, the local jeweler, as he stopped in front of the Model Garage and handed a brightly colored circular to Gus Wilson, veteran auto mechanic.

"Can you get one and fit it to my car?" he asked. "The circular says it's a new invention that will give twice as much mileage on the same gasoline and make the motor more powerful."

Gus grinned disgustedly as he thumbed the circular.

"I've seen this one before," he said. "It's a phoney gadget that doesn't work."

"But it's a patented invention," Southby protested. "Surely it must be some good, or the Government wouldn't issue a patent. Besides, look at all the testimonials. There's one from a man with a car just like mine. He says he got forty-seven miles on a gallon of gas."

"I don't care if he said he'd traveled from New York to 'Frisco on a thimbleful," Gus growled. "And the fact that it's patented doesn't mean anything either. If somebody sent you a circular advertising a machine that would turn silver into gold, would you buy it?"

"Certainly not," said Southby. "I'd know it was a fake. But this isn't the same kind of a proposition."

"Oh, but it is," Gus maintained. "This fellow claims to know more about carburetors than all the experts of all the auto factories put together; and on top of that he's trying to sell you an idea that's at least fifteen years old. There's nothing new about a device that lets extra air into the auto manifold between the carburetor and the cylinder block. They were selling them years ago—and then they didn't work any better than they do now."

"Well, maybe you're right," grumbled Southby, "but the idea seems logical to me. If you let more air into the manifold when the motor speeds up you ought to get more power."

"That's how it looks at first glance," Gus explained, "but it's actually the other way round. Wait just a minute."

GUS walked into the garage and rummaged around in the drawer of one of the workbenches. Then he came out again with a long piece of glass tubing and a small glass with some mercury in it.

"Years ago," he began, "I had an argument about one of these gas savers, and I worked out this way of proving my point.

"First we'll disconnect the air hose from your windshield wiper and slip it over the end of this glass tube. Then we'll stick the end of the tube in the mercury. Now start your engine and see what happens."

Southby stepped on the starter and then came around to watch Gus.

"Now your motor is idling nice and smooth," said Gus, "and you'll notice that the mercury has crawled up the tube quite a ways.

"Joe," he said to Joe Clark, his partner, who had joined the two men, "step on the throttle a minute."

Joe did as requested and Southby noted that the instant the throttle was opened the mercury in the tube dropped.

"See what happened?" exclaimed Gus. "When you don't need any extra air in the manifold—that is, when the motor is idling slow—there's lots of pull or, in other words, pretty good vacuum in the manifold. But when you open the throttle, the pressure goes right down. How in the world can any device give results that's up against pressure conditions like that? The more you open the throttle, and particularly on a steep hill where the motor is slowed down by the load, the less difference there is between the pressure inside the manifold and the air pressure which could force in extra air.

"Huh," grunted Southby, "looks as if they had the cart before the horse."

"They certainly have," Gus agreed. "A laboratory made a test of manifold pressure a while ago with an automobile motor. They set the throttle for a five-degree opening and then put a load on the motor so that it could only turn five hundred revolutions a minute. The pressure inside the manifold was eleven pounds a square inch. Then they opened the throttle to twenty degrees and, of course, they had to put a lot more load on the motor to keep it down to five hundred revolutions. The pressure inside the manifold went up to fourteen pounds. Not an awful lot of air is going to squirt into the manifold when the pressure inside is fourteen pounds and atmospheric pressure outside is only fourteen and seven-tenths pounds. They tried the same stunt with the motor running at two thousand revolutions a minute. With a five-degree throttle opening, the pressure in the manifold was three pounds, and when they opened the throttle up to twenty degrees the pressure went up to eleven pounds. That's exactly the same story all over again. If the extra air could do any good at all, it would be needed at the wider throttle opening, which is just where you wouldn't get it."

"How about all those testimonials?" asked Southby.

"Well," said Gus, "it's astonishing how many people like to fool themselves. Besides that, most carburetors are set for too rich a (*Continued on page 135*)

GUS SAYS—

LOTS of drivers get the idea that it's up to the fellow behind to watch out for himself when the brakes have to be jammed on real sudden. Jabbing your hand out to signal a stop and slamming the brake pedal down may be legal, but it isn't good sense. Figure out what the bird in front is going to do. Then you won't wear chunks off the brake linings to keep from slamming him.

POPULAR SCIENCE HOME WORKSHOP

Articles on Furniture, Models, Toys, Sporting Equipment, and All Forms of Craft Work—Better Shop Methods—The Shipshape Home

A bench and a seat that will add to the comfort and beauty of any lawn or flower garden.

Building Garden Seats of Wood

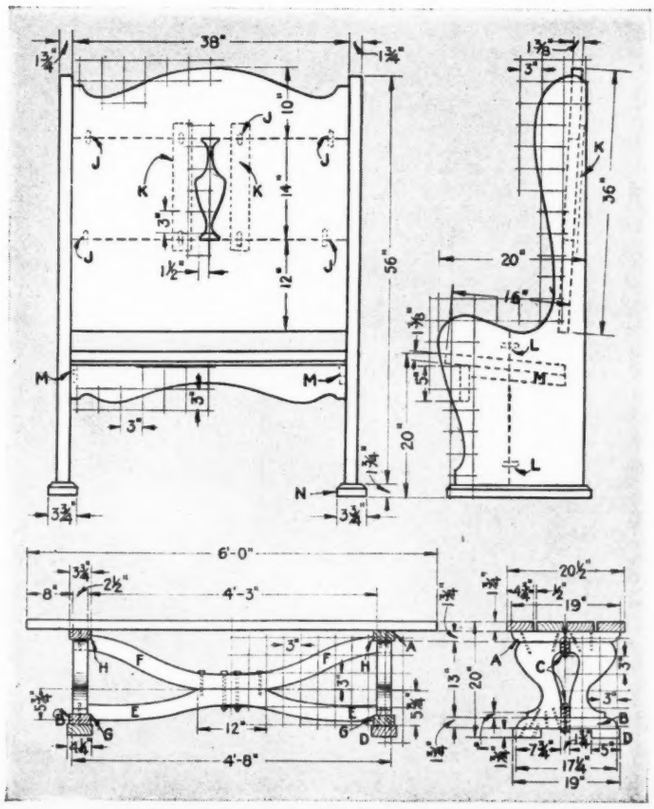
By

CHARLES A. KING

HAVING a garden and being able to work in it and improve it is one thing, but the joy of being able to sit down in it and enjoy its beauty is another. What garden would not be improved by the attractive and easily constructed garden bench and seat illustrated? They form a perpetual invitation to lounge happily and restfully in the cool shade of the foliage.

Pine, cypress, redwood, whitewood, or poplar may be used in the construction of these two pieces. Avoid woods that will not stand the weather.

In making the bench, draw the shape of the end pieces by laying out the design on 3-in. squares. The ends are made in two pieces, each of which can be cut from a 2½ by 8 by 13 in. piece of wood. Cut them with a compass, turning, or band saw (or have them cut at a shop) and spokeshave the edges.



Dimensions of the seat and bench. The back of the seat is made in three sections and the sides in two. Four pieces are used for the bench top.

The two caps *A*, 1¾ by 3¾ by 19 in., and the two bases *B*, 1¾ by 3¾ by 17¼ in., should be made next; round the ends of these as shown. With twenty-penny spikes assemble the ends, leaving 1¾ in. between the two pieces to receive the stretcher and braces as at *C*. Make the four feet *D*, 1¾ by 4¼ by 5 in., and spike them in place. The stretcher *E*, 1¾ by 5¾ in. by 4 ft. 8 in., should be shaped as indicated with notches at *G*. Braces *F* can be cut from two pieces of 1¾ by 5 in. by 2 ft. 6 in. stock marked to the curve by using 3-in. squares. Assemble the ends and stretcher with ⅜-in. bolts as suggested. Hold the ends vertical with stay laths, fit braces, being sure the notches *H* are accurately cut because these insure stability, and assemble with ⅜-in. bolts and lag screws.

The 1¾ by 4¾ in. by 6 ft. pieces for the top or seat are fastened with sixteen-penny spikes to cap *A*. With a plane cut two or three shavings from all sharp corners of the top and round all corners with No. 2 sandpaper. Then

give the completed bench two or three coats of white lead and oil paint; and if you wish to add contrast, touch the edges and the ends with a different color.

IF DESIRED, the back, seat, and ends of the garden seat illustrated on the preceding page may each be assembled and the ends of each piece squared at the mill so that the worker will have little to do but smooth the band-sawed edges and assemble the different members, using twenty-penny spikes or lag screws.

The back is made up of three pieces of 1⅜-in. plank, 3 ft. 2 in. long. Band saw the 10-in. toppiece to the curve shown, which can be transferred to the wood by drawing the 3-in. squares indicated. The vase-shaped ornamental hole may be cut from the 14-in. piece by cutting the plank in the middle, fastening the two pieces together temporarily with eightpenny finishing nails, and reproducing the curves of the vase by the use of the 3-in. squares. By sawing both pieces at once, the symmetry of the curves is assured. Assemble the back by placing all pieces with the ends exactly flush; fit them together with ½-in. dowels as at *J*, and in the middle with cleats *K*, ¾ by 2½ by 20 in. long, fastened to the back with 1½-in. No. 10 screws.

The ends are made up of two 1¾ by 10 in. by 4 ft. 8 in. and two 1¾ by 10 by 24 in. pieces. Fit these pieces together, place the dowels as at *L*, and transfer the curves. The pieces may be taken down, band sawed, and reassembled with glue. The seat is 1⅜ by 16 in. by 3 ft. 2 in., and the curved stretcher 1⅜ by 5 in. by 3 ft. 2 in. Smooth all edges with a spokeshave and file, and sandpaper all exposed surfaces.

Place ⅞ by 2 in. cleats at *M* to support the seat. Mark carefully the location of both seat and back. Coat the end wood joints with white lead and assemble with twenty-penny spikes. Be careful that the wood is not marred by hammer marks. The spike heads should be set well beneath the surface of the wood to allow for puttying.

Lay the seat on its back, get out the 1¾ by 3¾ by 20 in. feet *N*, and spike them on the bottom of the ends after treating the joint thoroughly with white lead.

Round all of the exposed corners with sandpaper to prevent splintering. Cover with a priming coat of white lead and oil, working it well into all joints and end wood, and finish with two coats of white lead paint, colored to suit.

An Easy-to-Build Model of the *DO-X*

Size of *DO-X:* span 157.8 ft.; length, 131.2 ft.; height, 33.6 ft.; hull width, 15.8 ft.

By

DONALD W. CLARK

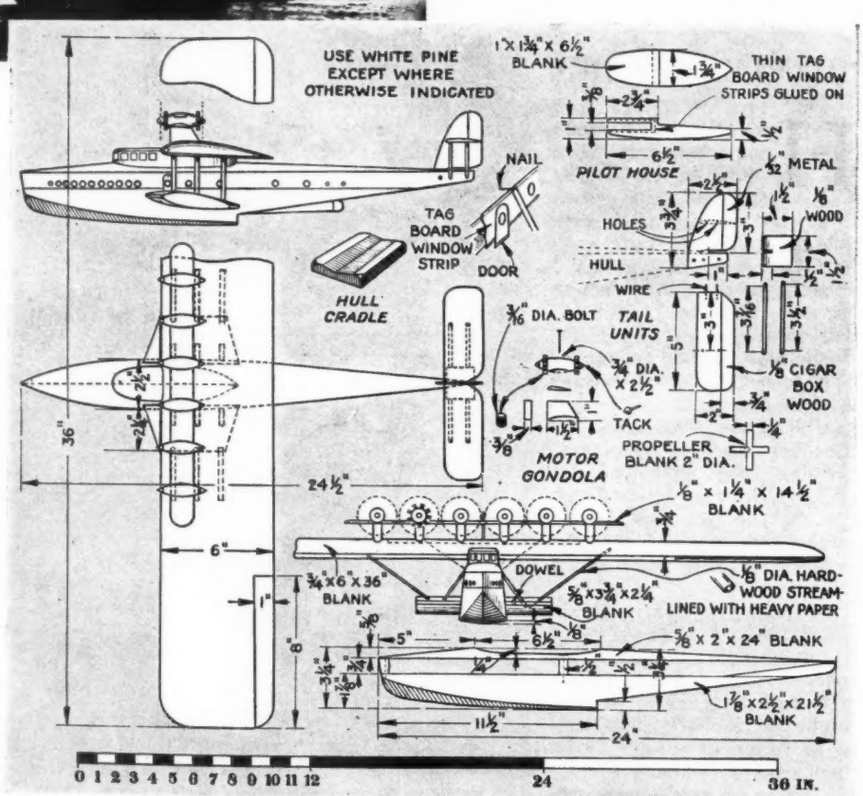
BY FAR the most gigantic of all seaplanes, the Dornier *DO-X* forms a most unusual and spectacular subject for the model maker.

This model is built along the same simple lines as the previous toy models in the present series (P. S. M., Apr. '30, p. 110; May '30, p. 124; and June '30, p. 95), but being much larger and containing more parts, it will require more time to complete.

The hull, instead of being whittled from a single block as in the previous models, is built up of several pieces as shown in the drawing of the hull details. Straight, clear-grained, soft pine can be used as the stock. Making the hull hollow has the advantage of giving the plane a more realistic appearance when the tagboard window strips are glued on.

Cut out and shape the main wing, pontoon-wings, pilot house, streamlined motor supports, auxiliary wing, and six motor gondolas. In assembling the members, attach the stub-wing pontoons to the hull with dowels. Note that the short wings taper from 4¼ in. wide at the hull to 3½ in. at the ends and slant downwards ¾ in. from front to back. Use hardwood rods ⅜ in. in diameter for all the wing struts and streamline the main struts with a paper covering. The tail units are made from thin wood and metal and the propellers from 2 in. diameter thin metal blanks.

Unless a more brilliant color scheme is preferred in order to please the children, the hull should be painted a cream color; the wings, tail, and stub-wing pontoons, lemon; the motor gondolas, cream; and the propellers and trimmings, black.



The motor cylinders are simulated by screwing nine ⅜-in. lengths of ⅜ in. diameter bolts into each end of the six motor gondolas. The hull, which consists of five pieces, is assembled with glue and brads.

How to Spray-Finish Furniture

The machine method of giving your woodwork a flawless surface . . . and a davenport table design

By WILLIAM W. KLENKE

Architect, Teacher, and Specialist in Woodwork

After the filler has set for about twenty minutes, rub across the grain with a piece of burlap, cotton waste, or cloth.

"FINISH," as the term is used in connection with cabinetwork, means the staining, filling, shellacking, lacquering, varnishing, oiling, waxing, painting, or enameling of a piece of furniture or other woodwork so as to enhance its beauty, to give it a smooth and durable wearing surface, and to preserve and protect the wood and joints from the weather or atmospheric changes.

Within the last few years great strides have been made in finishing methods so as to speed up and lighten the work. This change has come about largely through the use of quick-drying lacquer in place of varnish and the introduction of the electric spraying machine.

Too much emphasis cannot be placed on the importance of properly preparing the surface of the wood before attempting to apply the finish. If you hurry over this part of the work, the results will be disastrous. In a previous article (P.S.M., Apr. '30, p. 75) I explained the use of portable sanding machines in connection with finishing; but whether the sandpapering is done by machine or hand, it must be thorough.

If you intend to stain a piece of furniture, you may use either a ready-prepared stain or mix one of your own. Personally, I prefer to use a water stain for most of my finishing, although entirely satisfactory results can be obtained with other types of stain. Generally speaking, the water, spirit, and acid stains give a clearer, deeper, richer, and more lasting color than oil stains, but they raise the grain of the wood, whereas oil stains do not, at least to any appreciable degree.

Allow at least eight hours for the stain to dry, then apply a very thin coat of shellac with the sprayer or by hand. The shellac will make the raised fibers brittle, so that a rubbing with No. 00 sandpaper will cut them down, leaving the surface smooth.

If the wood you are finishing is open grained, apply one or two coats of good paste wood filler of a color to match the stain. Filler, which is sold in 1-lb. and larger cans, must be thinned with either turpentine or benzine to the consistency of cream. The object of the filler is to fill up the open pores of the grain. After applying the filler rather generously with a brush, allow about twenty minutes for it to set; then wipe off the surface by rubbing across the grain with burlap, cotton waste, or old rags. Be sure to get all of the corners clean. This can be accomplished best by folding a rag over a blunt, chisel-pointed stick. After the filler once hardens, it is impossible to wipe it off, so be thorough.

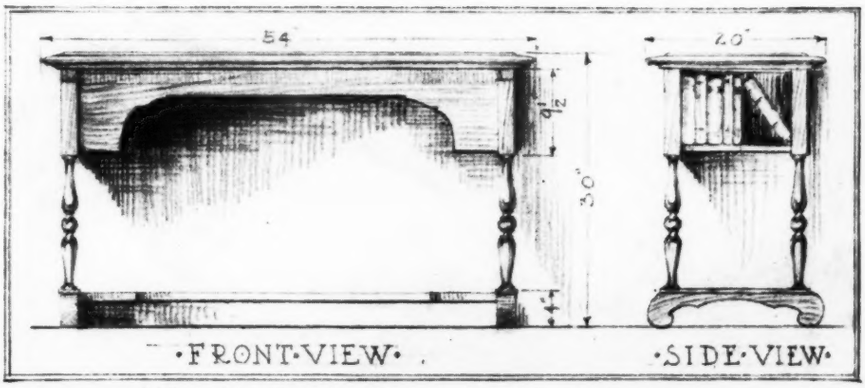
Allow at least eight hours for the filler to harden, then apply one thin coat of shellac with the spray or by hand. When dry, rub it down lightly with No. 00 sandpaper. Follow this with four or five spraying coats of clear lacquer.

The greatest care must be exercised in cleaning the nozzle, strainer, container, and entire system of the sprayer after you finish using it. If the finishing material is allowed to harden, the various parts will become clogged up. Be sure, too, that the motor is kept well lubricated. It is best to apply many thin coats, rather than a few heavy coats; this insures a smoother and finer surface. Do not allow too much spray to fall on any one part, otherwise the lacquer will run and sag, giving an unsightly "curtain" effect to the job.

When the finishing is to be done with a sprayer, take care to avoid sharp or pointed projections, as it is very difficult to get an even coating on such parts.

As a project to accom-

Above: A view showing the construction of the spray gun. *Right:* The spray can be effectively controlled through the proper choice of nozzle.



The long graceful lines of the table finish off the otherwise unattractive back of a davenport or divan. Its side shelves and spacious bottom stretcher supply ample room for current magazines and books.

pany these suggestions on finishing, I have chosen a davenport table. It makes a fine looking piece of furniture for the living room and gives the builder valuable experience in large surface finishing.

Step No. 1—The Stock. Get out the various pieces of stock, using the jointer (small planer) for truing all the surfaces and edges, and the circular saw for ripping to the correct width and thickness and for cutting to length. The use of the jointer and the circular saw has been previously explained in detail (P.S.M., Jan. '30, p. 78; and Nov. '29, p. 88).

Step No. 2—The Turned Legs. On the lathe, turn the four legs to design (see P.S.M., Mar. '30, p. 78).

Step No. 3—Making Joints. Lay out and make all joints. If you choose to use the mortise and tenon construction, cut all mortises first and fit the tenons to them to insure perfectly tight joints.

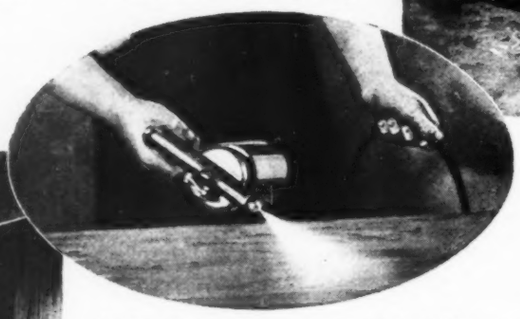
Step No. 4—Curved Outlines. Lay out all curves full size on heavy paper or cardboard and transfer these outlines to the wood. Use the band saw for cutting these parts (see P. S. M., Feb. '30, p. 86).

Step No. 5 — Cleaning Up. Thoroughly sandpaper all parts (P.S.M., Apr. '30, p. 76).

Step No. 6—Assembling. Set the entire table together *without glue* to make sure that all members fit together. While they are held in place, mark the various companion pieces Nos. 1 and 1, 2 and 2, and so on in order that the pieces will go together correctly when the gluing is done. The gluing is accomplished in two separate operations. Be sure to test the work for squareness and see that the top frame is in line. Use plenty of the best glue and allow the work to set between clamps undisturbed. Throw a little fine sawdust over the glue as it oozes out; this will absorb it sufficiently to allow it to be peeled off immediately afterwards with a chisel.

The side rail design can be changed and blocks inserted under the legs, if desired, as shown above.

On vertical surfaces, care must be taken not to allow the finish to get so heavy that it sags.



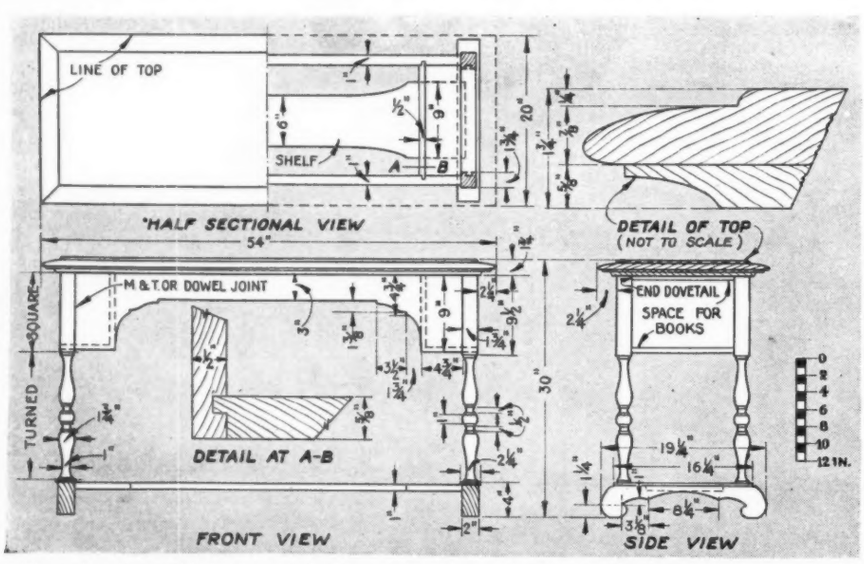
On flat surfaces, the spray gun may be held at an angle so that the work will always be in full view.

Step No. 7—The Top. The upper member of the top has a 2¼ in. wide framework glued to the underside to give the appearance of strength and thickness. The molded edges can be worked out by hand or run on a shaper machine.

Step No. 8—Final Cleaning Up. Remove all excess glue with a sharp chisel, cutting across the grain where possible. Sandpaper thoroughly all parts with Nos ½, 0, and 00 sandpaper, always rubbing with the grain if practicable.

Step No. 9—Finishing. Stain, fill, and finish as explained in the first part of this article.

In his next article, which is scheduled for early publication, Mr. Klenke will describe the uses and care of an overhead pivoted saw of the radial type. This article will be the thirteenth in this series by Mr. Klenke, which began in the August, 1929, issue.



Dimensioned assembled views of the davenport table and details of the bookshelf construction and the molded edge on the top. An alternate design is shown in photograph at the top of the page.

WAYS TO STRAIGHTEN CUPPED BOARDS

BOARDS that have become cupped and bent because of improper piling during storage may, in most cases, be straightened by either of the following methods.

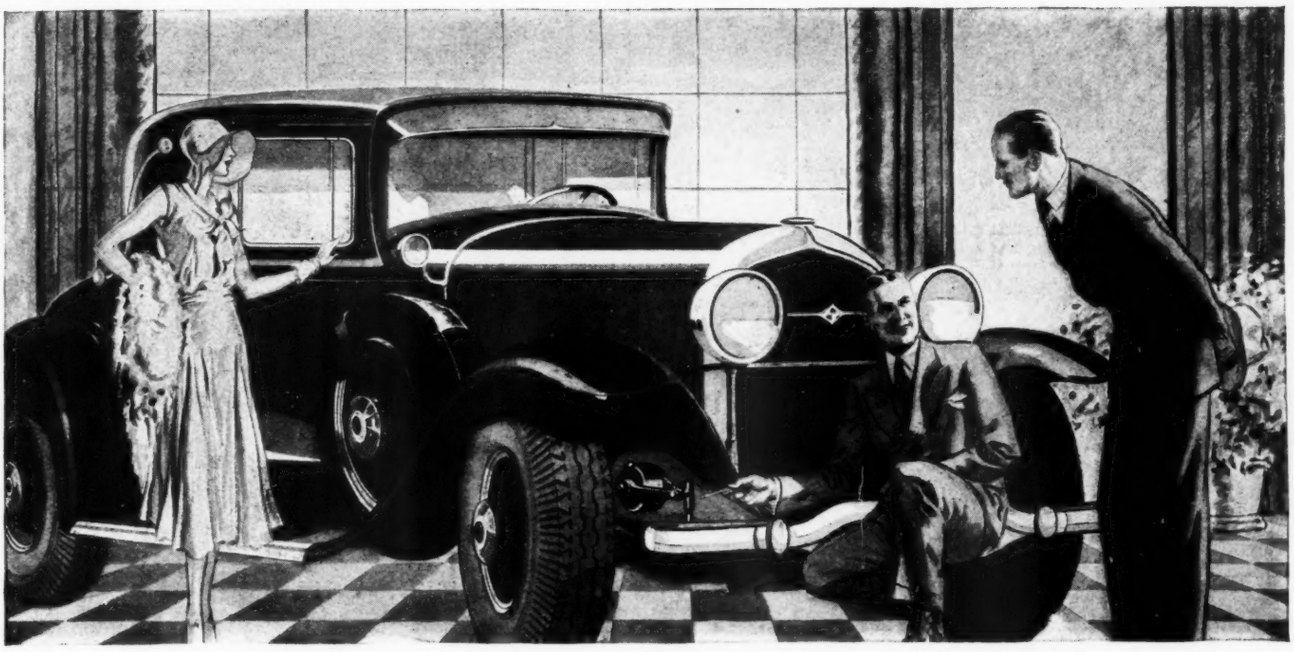
If the weather is warm, place the board with its convex or curved side up upon freshly watered grass in a sunny place. The heat of the sun will dry out the convex side, while the moisture from the grass will tend to swell the concave or hollow side.

When the season makes this method impossible, hold the concave side of the board over the spout of a teakettle of boiling water until the surface grain has become thoroughly moistened. Then stand the board with its convex side near a stove or other heating device until it becomes straight. The board should be watched carefully and removed as soon as it is straight or it is likely to bend in the opposite direction.

In either case, the board should be held flat with weights until it is ready for use.

Only slight bends, of course, can be effectively straightened by these methods, and lumber so treated should not be used in fine pieces of furniture or in work where a high degree of accuracy is desired —EVERETT R. MARTIN.

When the dealer says . . . .



"This car is equipped with HOUDAILLE Shock Absorbers"

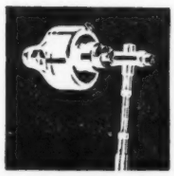
PRONOUNCED "HOO-DYE"

You know that the maker has enough regard for his customers' comfort and safety to protect them with the most efficient and expensive shock absorbers made.

He is eager to have you try a rough road demonstration to prove how the worst of rutted roads are reduced to velvet smooth undulations at speed that might spell disaster to a car not so well equipped.

Insist on a Rough Road Demonstration

The Houdaille dealer in your locality is ready to show how you can have added comfort and safety in your present car



Houde Engineering Corporation

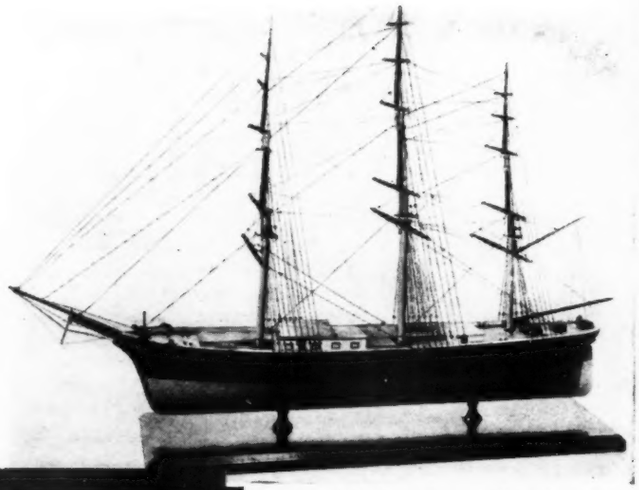
BUFFALO, N. Y.

A DIVISION OF HOUDAILLE-HERSHEY CORPORATION

Pioneers and World's Largest Producers of Hydraulic Double Acting Shock Absorbers

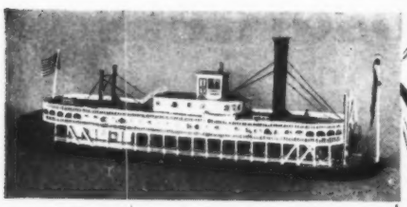
A Choice of Ships for the Model Maker

One of the simplest of our historic ship models is the Viking ship illustrated above. Blueprints Nos. 61 and 62 give full size plans for constructing the hull, deck fittings, and sail (see page 103).

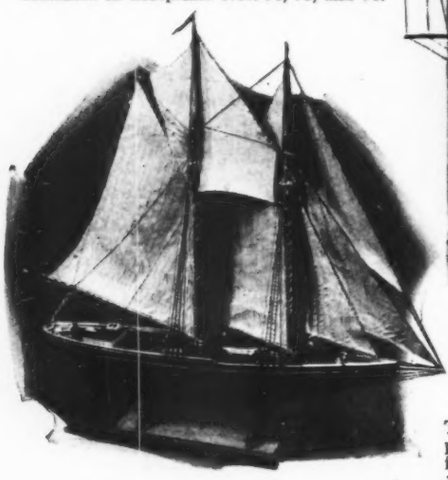


A model of the famous *Sovereign of the Seas*, one of the fastest and finest clippers of her time. Full size drawings of this model are contained in POPULAR SCIENCE MONTHLY Blueprints Nos. 51, 52, and 53.

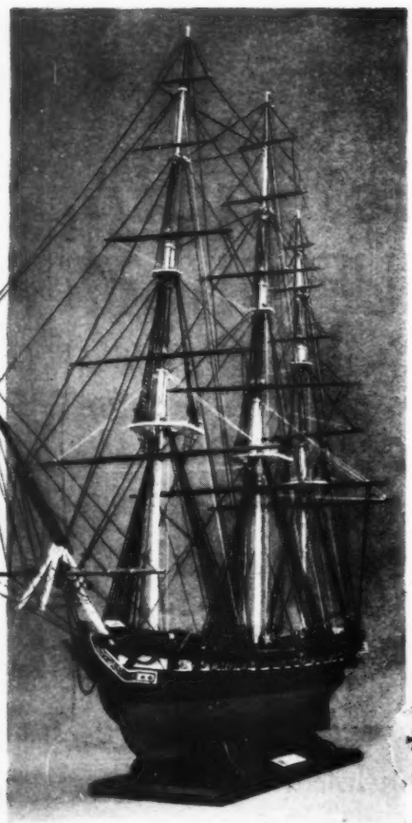
Blueprint No. 92 contains full size plans for the construction of this 8-in. model of a rakish Baltimore clipper of about 1812. The sails as well as the hull are carved from wood.



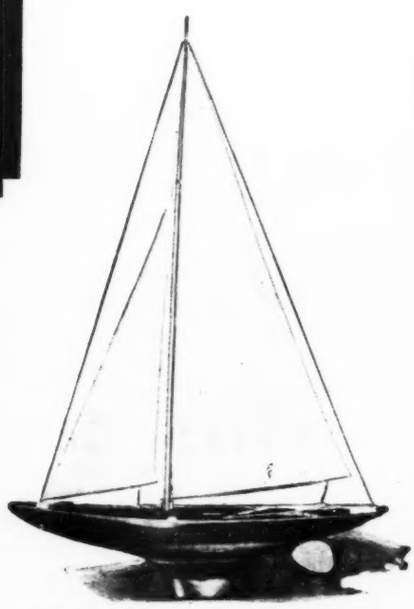
Plans for building this model of the speedy *Buckeye State*, a Mississippi River boat, are contained in Blueprints Nos. 94, 95, and 96.



The racing fishing schooner *Bluenose* is at present holder of the international trophy for vessels of her class. Plans for building the 17½-in. model illustrated at the left are included in Blueprints Nos. 110, 111, and 112.



A model of the historic *Constitution* (*Old Ironsides*) as she appeared during the War of 1812. Plans for the construction of this model are given in Blueprints Nos. 57, 58, and 59.



For racing, few models can equal the 42-in. yacht model *Sea Scout*. The drawings for this model are contained in Blueprints Nos. 106 and 107. Full size plans for a 20-in. racing model are contained in Blueprint No. 48.

Not many models match a Spanish galleon in decorative value. The hull gleams with gold and brilliant colors, and even the sails are adorned with paintings. Blueprints Nos. 46 and 47 give the full details of construction.

"The Best Insurance Against Tube Troubles ...RCA Radiotrons"

says

JOHN S. GORMAN

Vice-President and General Manager

GULBRANSEN COMPANY

"WE strongly recommend that every Gulbransen Radio owner use RCA Radiotrons. Our engineers use RCA Radiotrons in laboratory work and for testing, as they are of uniformly high quality and give the best results. We find that RCA Radiotrons not only safeguard sensitivity and selectivity and insure Gulbransen realism, but act as the best insurance against vacuum tube troubles. It's good common sense to demand RCA Radiotron quality for both first equipment and replacement."

This is the 20th in a series of endorsements of RCA Radiotrons by the leading radio set manufacturers.

RADIO ENGINEERS ADVISE:

Replace all the vacuum tubes in your radio set with RCA Radiotrons at least once a year. This is the only sure way to maintain good performance and minimize disagreeable noises and other troubles caused by inferior tubes. RCA Radiotrons will give you the maximum in selectivity, sensitivity and *tone quality.*

Old tubes may impair the performance of the new

RCA RADIOTRON CO., INC., HARRISON, N. J.

RCA Radiotrons

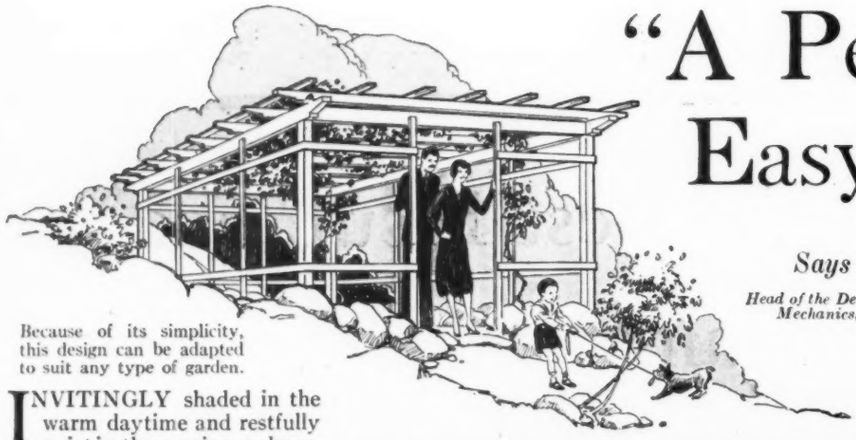
THE HEART OF YOUR RADIO SET

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

"A Pergola Is Easy to Build"

Says EMANUEL E. ERICSON

Head of the Department of Vocational Education and Community Mechanics, State Teachers College, Santa Barbara, Calif.



Because of its simplicity, this design can be adapted to suit any type of garden.

INVITINGLY shaded in the warm daytime and restfully quiet in the evening coolness, a garden pergola is a great incentive toward living outdoors during the summer months.

The pergola illustrated is especially easy to build. It will repay in one season the small cost of the materials needed in its construction; and even a small amount of working time, applied intermittently, will quickly show results. It is not essential to have level ground. The pergola under discussion (see Fig. 1) was built on ground sloping about 3 ft. in 12 ft. If rocks are used to build up the floor, the slope is not objectionable and may even add to the attractiveness of the plan.

The following materials will be needed:

Lumber: 4 pcs. 4 by 6 in. by 7 ft. 6 in. for corner posts; 2 pcs. 3 by 6 in. by 17 ft. for side beams; 2 pcs. 3 by 6 in. by 10 ft. 8 in. for end beams; 8 pcs. 2 by 4 in. by 13 ft. for rafters; 7 pcs. 1 by 2 in. by 17 ft. for slats over rafters; 4 pcs. 1 by 3 in. by 15 ft. 2 in. for rails for sides;

Above: Fig. 1. A pergola forms a shady retreat. *Right:* Fig. 2. How a post can be braced while the concrete is hardening.

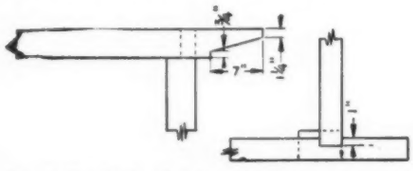


Fig. 3. Detail showing how the beam across each end may be dadoed 1 in. into the side beams.

8 pcs. 1 by 3 in. by 4 ft. for rails for ends; 8 pcs. 1 by 3 in. by 7 ft. 8 in. for upright braces. Cement: From 2 to 4 sacks, depending upon the lay of the ground. Gravel: From ¼ to ½ cu. yd.

Redwood is the most durable and probably the most attractive lumber, but Douglas fir or common pine may be used. For permanence, redwood, chestnut, cypress, or other very durable wood should be used for the posts. The lumber can be purchased surfaced or rough, according to the fancy of the builder. If desired, the surfaces of the posts, rafters, and supporting beams can be given an attractive "adz finish" by chipping the surface with a hatchet, or by rough cutting it with an old-fashioned plane.

The following steps in construction are recommended:

1. Lay out the exact rectangle on the ground by driving stakes beyond each corner and tying cord between them to intersect at the corners. Check diagonally from corner to corner for squareness.

2. Establish the floor level. Build forms for the concrete up to a height where the cement will come 4 in. above the top of the floor at all corners.

3. Cut corner posts to exact lengths after marking them for the distance they will go into the cement; this allowance may be 4 in. Also cut the beams which are to rest on these posts.

4. Mix concrete of 1 part cement and 4 parts coarse gravel and set the posts in this. To assist in placing them correctly, lay the top beams along the ground for a measure.

5. "Tack" the 1 by 3 in. rails on the posts to hold them the proper distance apart at the top (see Fig. 4).

6. Test the posts for plumbness. Brace the structure against the ground if necessary and let the concrete set before proceeding further (Fig. 2 shows one corner post braced in this way after the wood form has been taken from the concrete).

7. Before putting the supporting beams in place, chisel out recesses for the tops of the upright slats or braces in order that these may come flush with the posts and allow the horizontal rails to go outside the posts without bending.

8. If desired, join the end beams to the side beams with a shallow dado or housed joint to add strength (see Fig. 3).

9. Cut the rafters to length and make the decorative cuts on the ends.

10. Put beams, rafters, and roof slats in position (see Fig. 4).

11. Cut and nail on the upright pieces and horizontal rails.

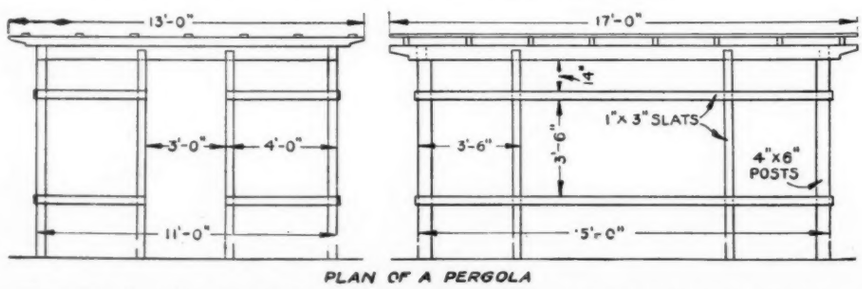
12. Apply a suitable stain (or paint, if preferred; for directions see P. S. M., June '30, p. 88).

A satisfactory brown color can be obtained by mixing burnt umber (ground in oil) with raw linseed oil and turpentine in equal parts.

13. Level the ground for the floor, laying in the necessary rocks to hold the ground on the low and high sides, and finish around the concrete corners with rocks.

14. Flagstones for the floor, if natural stones are not available, may be obtained from broken-up sidewalks or old cement floors.

15. Sow grass seed in the spaces between the stones and water diligently. Plant vines around the outside, placing them near the uprights.



PLAN OF A PERGOLA

Fig. 4. The dimensions given need not be followed but should serve to give an idea of the general proportions of the structure. Redwood is one of the most durable woods to use for pergola construction.

THE INCREASING USE OF THE TELEPHONE REQUIRES THE EXPENDITURE OF HUNDREDS OF MILLIONS ANNUALLY FOR EXTENSIONS AND IMPROVEMENTS

It keeps faith with your needs

An Advertisement of the American Telephone and Telegraph Company

You have found a constantly growing use for the telephone. You have learned its value in business. You have found it helpful in keeping contact with family and friends. Its increasing use has given the telephone its humanly important place in modern life and requires the expenditure of hundreds of millions annually for extensions and improvements.

In 1929 the Bell System's additions, betterments and replacements, with new manufacturing facilities, meant an expenditure of 633 million dollars. During 1930 this total will be more than 700 millions.

Definite improvements in your service result from a program of this size and kind. They start with the average time required to put in your telephone—which in five years has been cut nearly in half. They range through the other branches of your service, even to calls for distant points—so that all but a very few of them are now completed while you remain at the telephone.

In order to give the most effective, as well as the most economical service, the operation of the Bell System is carried on by 24 Associated Companies, each attuned to the part of the country it serves.

The Bell Laboratories are constantly engaged in telephone research. The Western Electric Company is manufacturing the precision equipment needed by the System. The staff of the American Telephone and Telegraph Company is developing better methods for the use of the operating companies. It is the aim of the Bell System continually to furnish a better telephone service for the nation.

Novel Kinks to Use on a Car

Shellac as a cure for leaky gas tank —How to make arm rest for driver—Simple device to test valves

ALTHOUGH the driving position in modern motor cars is far more comfortable in many ways than it was in older type vehicles, few make provision for an arm rest for the driver. Figure 1 shows a simple arm rest designed to hook over the window regulator of the door at the driver's side. It consists of a sheet iron bracket to which is attached a padded wooden strip to form the arm rest. The length of the bracket and the dimensions of the arm rest must, of course, be arranged to suit the car.

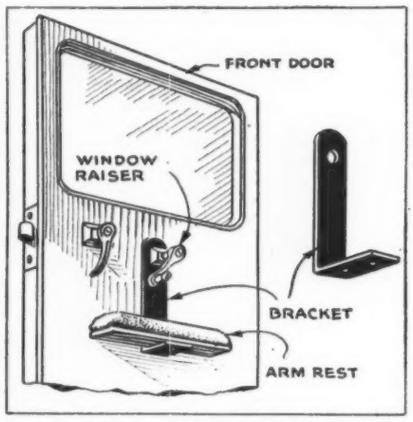


Fig. 1. A sheet iron bracket with padded wooden strip hooks on door to form driver's arm rest.

SIMPLE VALVE TESTER

WHILE there are excellent gages now being made for testing the tightness of a valve after grinding, the amateur auto mechanic can satisfactorily test valves after grinding by the arrangement shown in Figure 2. An ordinary thin rubber ball is cut in two very carefully so as to leave a clean edge. The valve is held off its seat while the inverted half of the ball is placed over it and squashed down. Then the valve is held tightly against the seat. If the valve is tight, the half ball cannot resume its shape.

Draining the gas tank, letting it stand until dry, and then coating with shellac stops leaks.

LEAKING GAS TANKS

OCCASIONALLY a gasoline tank develops a leak caused by a tiny opening in the seam or around one of the pipe connections. It often is possible to avoid soldering by draining the tank and allowing it to stand several days until it is completely dry. Then openings are plugged and a quart of shellac is poured in. The tank should be shaken so that the shellac will reach every part of the inner surface. Then the shellac is poured out again and the tank allowed to stand in the garage for several days until the shellac dries.

Difficulty may be encountered if the tank contained low grade gasoline. Such gasoline often contains enough kerosene-like material that it will not completely evaporate. Instead an oily film is left which will prevent the shellac from sticking to the metal. In such cases wash out the empty tank with high test gasoline.

FOOT REST FOR COACHES

IN MANY coaches the passengers on the rear seat are placed so far forward that there is a natural tendency to rest the feet against the backs of the front seats with decidedly bad effects on the upholstery. Figure 3 shows how to construct a simple foot rest that can be applied to each front seat to save the upholstery. Angle iron brackets are bent up as shown and attached by wooden screws to the bottom of the seat and the hardwood board attached to the brackets. This can be covered with rubber matting, if desired.

EXTENSION FOR JACK

FIGURE 4 shows a way to form a drop extension out of a heavy piece of strap iron. This drop extension will prove extremely useful in cases where it is necessary to get under the axle when the jack itself is too high. Do not attempt to make the drop extension out of light strap iron. The steel must be so thick that there will be no chance of the weight bending the lower angle and permitting the axle to slip.

The base area of many types of jacks is neither wide enough or long enough. They work well on hard surfaces, but are quite likely to tip over if an attempt is made to use them on sand or soft ground. This is particularly true when an extension is used. It is, therefore, desirable to fit an extra base to the jack as shown.

POPULAR SCIENCE MONTHLY awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to H. W. Swope, Danville, Pa., for his suggestion for repairing leaky auto gas tanks (shown and described in column two).

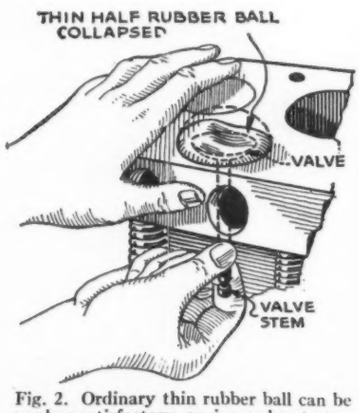


Fig. 2. Ordinary thin rubber ball can be used as satisfactory engine valve tester.

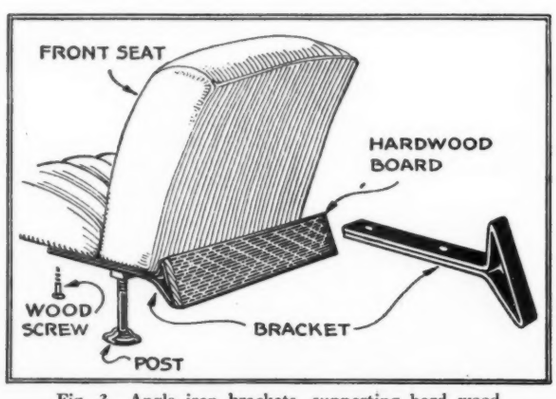


Fig. 3. Angle iron brackets, supporting hard wood board and attached to front seat, make foot rest.

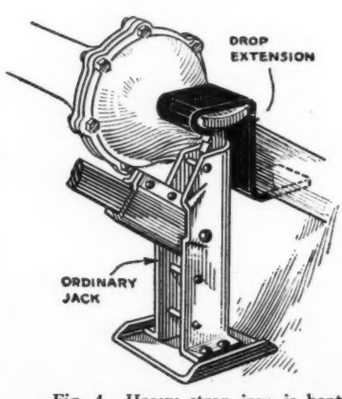


Fig. 4. Heavy strap iron is bent to make drop extension for jack.

News...if you drive a

Ford Model A Hudson
De Soto Dodge
Essex Reo

A new grade of Mobiloil is offered to scientifically meet the lubrication problem of your car...

Make this Chart your Guide

This abbreviated chart shows the correct grade of Gargoyle Mobiloil for most passenger cars. You will find the complete Mobiloil Chart at your Mobiloil dealer's.

NAMES OF PASSENGER CARS	1930 Engine		1929 Engine		1928 Engine		1927 Engine	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Auburn 6-85	AF	Arc.	....	....	....	....	....	....
" 6-66A, 6-80, 76	....	....	A	Arc.	A	Arc.	A	Arc.
" *other models*	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Buick	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Cadillac	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Chandler	....	....	A	Arc.	A	Arc.	A	Arc.
Chevrolet	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Chrysler 70, 77	BB	Arc.	....	....	....	....	A	Arc.
" Imperial	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
" *other models*	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Dodge Bros.	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Durant 614	AF	Arc.	....	....	....	....	....	....
" *other models*	A	Arc.	A	Arc.	A	Arc.	....	....
Elcar 6-70, 75	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" *other models*	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Erskine	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Essex	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Ford Model A	AF	Arc.	AF	Arc.	AF	Arc.	....	....
" Model T	....	....	....	....	....	....	E	E
Franklin	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Gardner 6-cyl. 136	AF	Arc.	....	....	....	....	....	....
" 8-cyl.	BB	Arc.	BB	Arc	BB	Arc.	BB	Arc.
Graham and Graham-Paige	BB	Arc.	BB	Arc.	BB	Arc.	....	....
Hudson	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Hupmobile	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
LaSalle	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Lincoln	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Marmon Big 8, 75, 8-79	BB	Arc.	....	....	BB	Arc.	BB	Arc.
" *other models*	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Moon 6-72	....	....	AF	Arc.	A	Arc.	....	....
" 8-80	....	....	BB	Arc.	BB	Arc.	....	....
" *other models*	....	....	A	Arc.	A	Arc.	A	Arc.
Nash Twin Ig. 8, 490, Adv. 6, Sp. 6, Twin Ig. 6	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Nash (*other models*)	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Oakland	BB	Arc.	A	Arc.	A	Arc.	A	Arc.
Oldsmobile	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Packard	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Peerless 61, 81	....	....	AF	Arc.	....	....	....	....
" 60, 69, 80	....	....	....	....	A	Arc.	A	Arc.
" *other models*	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Plymouth	A	Arc.	A	Arc.	....	....	....	....
Pontiac	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo (*all models*)	AF	Arc.	AF	Arc.	A	Arc.	A	Arc.
Studebaker Com'der 8	AF	Arc.	AF	Arc.	....	....	....	....
" President 8	BB	Arc.	BB	Arc.	BB	Arc.	....	....
" *other models*	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Whippet	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Willys-Knight	A	Arc.	A	Arc.	BB	Arc.	BB	Arc.
Windsor 6-69, 6-72, 6-75	AF	Arc.	AF	Arc.	....	....	....	....
" *other models*	BB	Arc.	BB	Arc.	....	....	....	....

Because—it will stand up better under the higher engine temperatures of today's fast driving, and last longer.

Because—it is heavier in body than Mobiloil "A" and lighter than Mobiloil "BB".

Because—it is made by the makers of the world's leading quality oils.

Because—it is the result of thorough engine and lubrication study by the most experienced staff of lubrication scientists in the world.

Because—it is made by the vacuum process in the world's most modern lubrication plants.

Because—it is made from the world's finest crudes, selected by the outstanding authorities on scientific lubrication.

Because—it sells at 30 cents a quart (35 cents in Southwest, Mountain, and Far Western States).

Add to the performance of your good car, the improved performance *correct lubrication* can give it. Let your Mobiloil dealer drain your crankcase today and refill with this outstanding new lubricant.

VACUUM OIL COMPANY

Makers of high-quality lubricants for all types of machinery

LOOK FOR THIS SIGN

Mobiloil "AF"

How to Add the Body and Canvas to Our Covered Wagon Model

By EDWIN M. LOVE

IF YOU are doing your bit to celebrate the Covered-Wagon Centennial by building the decorative model described last month (P.S.M., June '30, p.75), and if you already have the wheels and carriage completed, the next step is to add the body and canvas.

Those who missed the preceding installment can obtain a copy of the June issue for twenty-five cents from the Subscription Department. A great deal of work, too, can be saved by all those who undertake the construction of the model if they make use of the full size drawings contained in POPULAR SCIENCE MONTHLY Blueprints Nos. 118, 119, and 120 (see page 103).

BODY. *Sides:* Obtain the top curve by bending a stick around three nails, and gage the bottom after the top is cut. Score lines for the joints. Glue ⅛ by 7/16 in. cleats inside the front ends, and ¼ by 7/16 in. cleats at the rear.

Bottom: Score joint lines, and nail to the sides.

Front End: Add the cleats after scoring lines on both faces, and nail between the sides just back of the cleats at the end.

Paneling: Glue and nail rails and stiles in place.

Cleats: Three ⅛ by ½ in. cleats are placed inside each side. Besides the four main bottom cleats, an end-gate cleat is added.

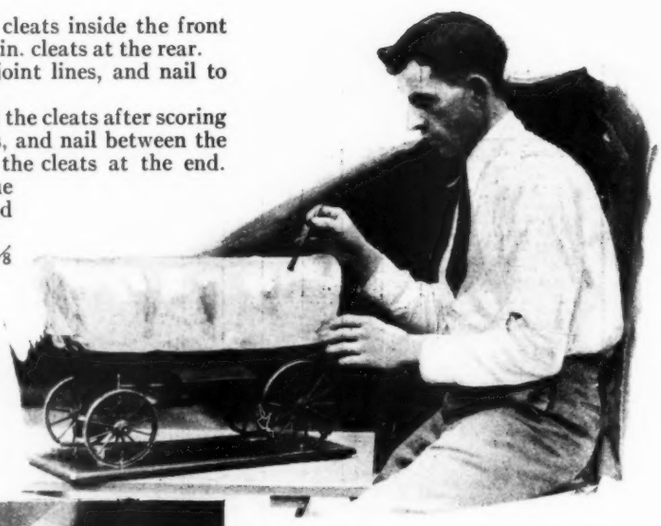
Irons: A metal bracket bolts against each inside cleat, and one against each side at each end. Chain hooks for the end gate are 1-in. No. 16 brads driven through "nuts" and cardboard washers outside, and washers inside, where they are bent to form hooks. The bow sockets are No. 22 gage metal bradded in place. Note the rod across the front of the box.

End Gate: It is well to nail this solid, as the hinges are weak. Form hinges by rolling the leaf ends around a brad, by making two saw cuts through the rolls, by breaking out the center section of one and the ends of the other, and by riveting in brads for pins.

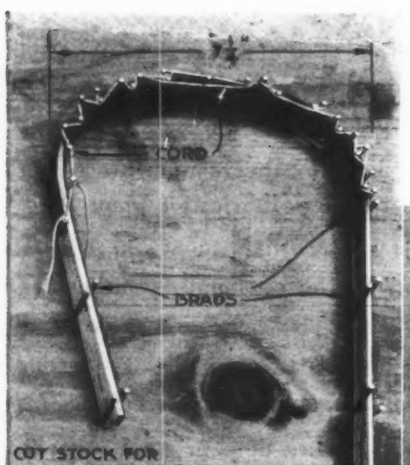
Side Boxes: Notch the backs for the rubber hinges, assemble, and nail in place. Rabbet backs for the rails if necessary.

Bows: Soak the strips overnight, and bend all five at once. If they do not bend easily, hold a flame under them while shaping. When secured in the form, steam them over the spout of a teakettle.

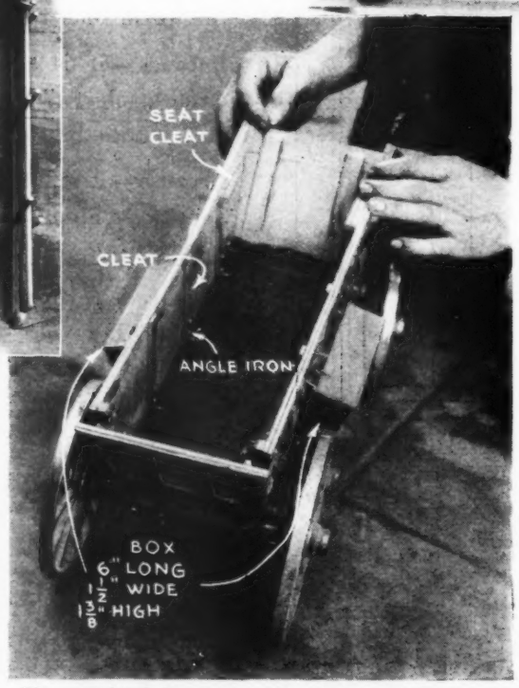
TONGUE. Straps edge the hounds and pole as far as the second large clip,



The author, Mr. Love, putting the finishing touches of color on his completed covered wagon model. Tongue and yoke are placed under the model.



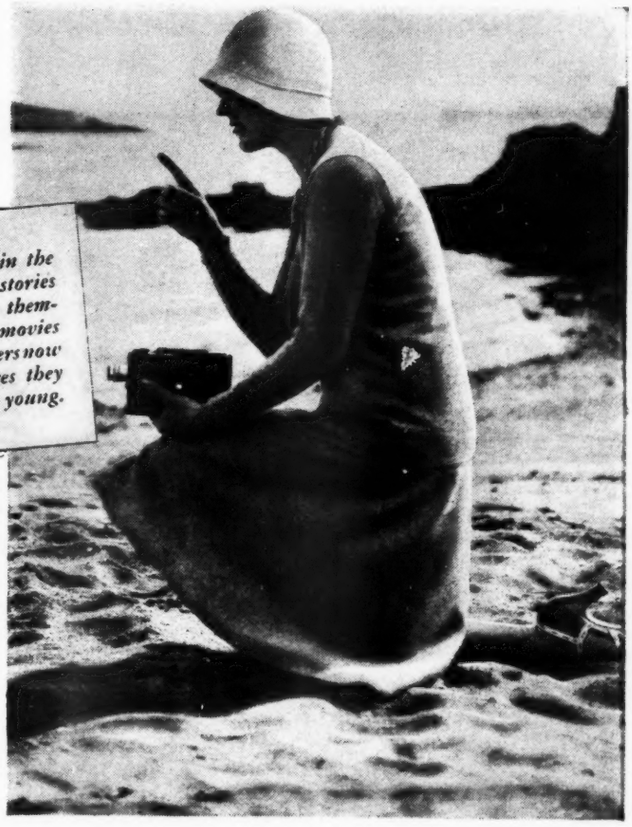
How brads and cord are used in the process of shaping the cover bows.



The completed box and carriage before the bows are placed. Note angle irons at the bottom of each cleat.

Find the Movie Star in Your family

Playing in the sand, acting stories they make up themselves. Take movies of the youngsters now . . . in pictures they stay always young.



Your own children . . .

starring in your own movies! There's the finest fun in all the world!

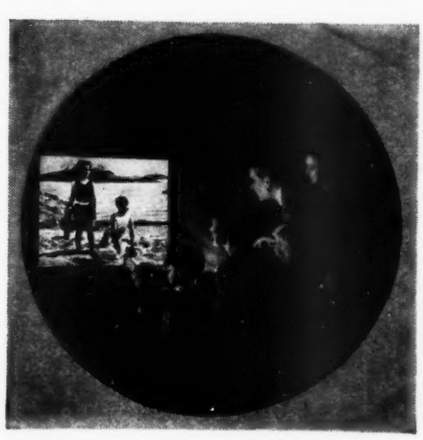
BROTHER thundering along the beach in a game of his own devising! And sister seriously building castles of sand, to be peopled with imaginary families.

The two of them . . . playing at leapfrog, learning to dog-paddle, rollicking or resting . . . just being themselves!

What form of entertainment can match it? What pleasure even compare? Your own children . . . stars of your own movies . . . to have and to treasure, to see again and again and again, long after that day on the beach is forgotten.

You need no one to tell you how to make interesting movies of your family. No need to worry about properties, atmosphere, scenery. Your fishing trips, your sailing trips, your hikes and picnics . . . sports . . . are perfect home movie material. Just take Ciné-Kodak along, press a lever and the picture is made, your vacation preserved for all time.

For Ciné-Kodak is the simplest of home movie cameras. You look through a finder and press a lever. Exposed reels go off to the nearest Eastman processing station . . . and in a few days you have them back, ready to show in your Kodascope projector. No charge for developing; that's included in the price of the film.



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while a strap runs the full length underneath. The spreader is half-lapped into the pole end. Bend the clips before shaping them with a file; and for bolts, use No. 18 escutcheon pins riveted over nuts.

YOKE. The eye is a U-bolt bent, passed through holes drilled in the wood and clips, and riveted over at the top.

To shape the bows, boil them in water for two hours, wind them with string, bend them around a bottle, slip the ends into the holes, and allow them to dry. Splits made when mortising for the keys can be disregarded, as they are characteristic of an old, weatherbeaten yoke. The keys are wedges notched on one edge so that they can be turned over in the mortises to prevent their working out.

BOX COVER. Use unbleached muslin, cut rectangular so that it projects 3 in. beyond the end bows and ¼ in. below the upper panel rails of the sides. Make a ¼-in. hem all around and place draw strings in the ends.

PAINTING. Wear off the corners on the paneling and elsewhere with a half-round cabinet file; and file "checks" in the ends of the boards.

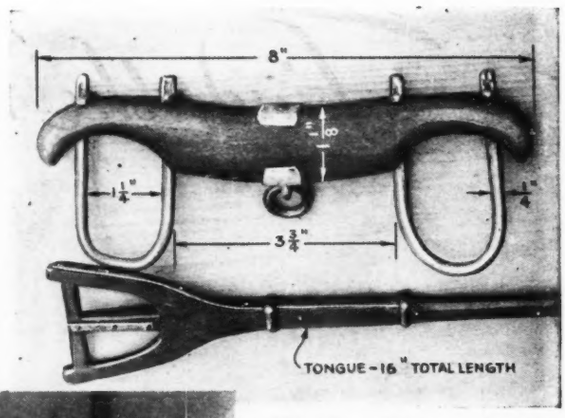
Glue and brad pieces of velvet, pile folded in, to the brakes. Glue and brad single thicknesses of velvet to the axletree ends where they will cover the inner ends of the hubs and represent sand boxes.

Coat the wood with two parts of dry burnt umber and one of lampblack, mixed with alcohol; and when dry, clean well with a scrubbing brush. Using a flat ⅜-in. lettering brush, coat all parts with light-red poster paint. Do not brush too thoroughly, and at all points where rain water could stand and soak in, as at the upper edges of panel rails and the adjacent parts, do not apply the red. The same is true of all edges and surfaces naturally subjected to rubbing, such as the side-box lid edges. The wheel spokes should have a thin coat, with none between the spokes, and very little inside of the felloes. When dry, rub vigorously with the scrubbing brush. Add a suggestion of blue-green stripes on the hubs, bolsters, axles, and body-panel stiles.

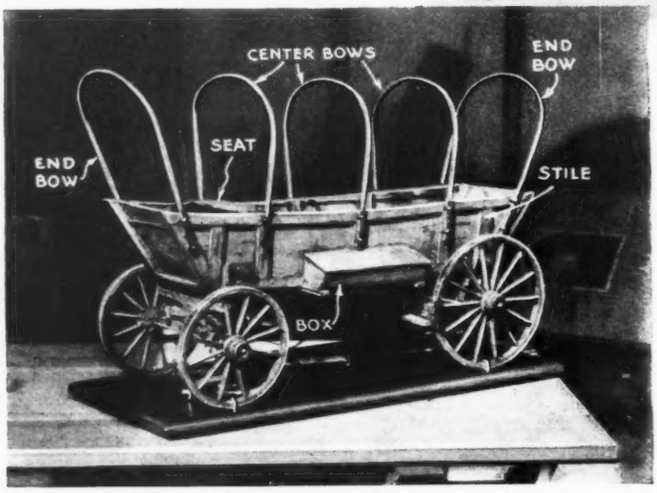
Protect the water color with a coat of four-hour clear varnish, thinned with an equal quantity of thinner, so that it will soak in and not leave a gloss.

Top: Secure the sides with brads driven into the bows and rails, beheaded and bent downward to form hooks. Pull the draw strings, gathering the ends properly, and tie the front strings to the cross rod. The rear strings cross each other and are fastened to the chain hooks. Two stitches taken in each corner, at the bows, take up any of the slack.

Coat the muslin with thin shellac. Go over it with mustard-yellow, red-brown, and a little orange poster paint, well blended at the edges and worked into the shellac with a brush moistened in alcohol. Leave one or two rather strong spots of color on each side and work in faint diagonal smudges of blue-green near the center bows on both sides.



The yoke and tongue. The bows for the yoke are ¼-in. dowel rod.



The completed model and base before the paint and cover were applied. Small screw hooks over the felloes of each wheel hold the model on the mounting.

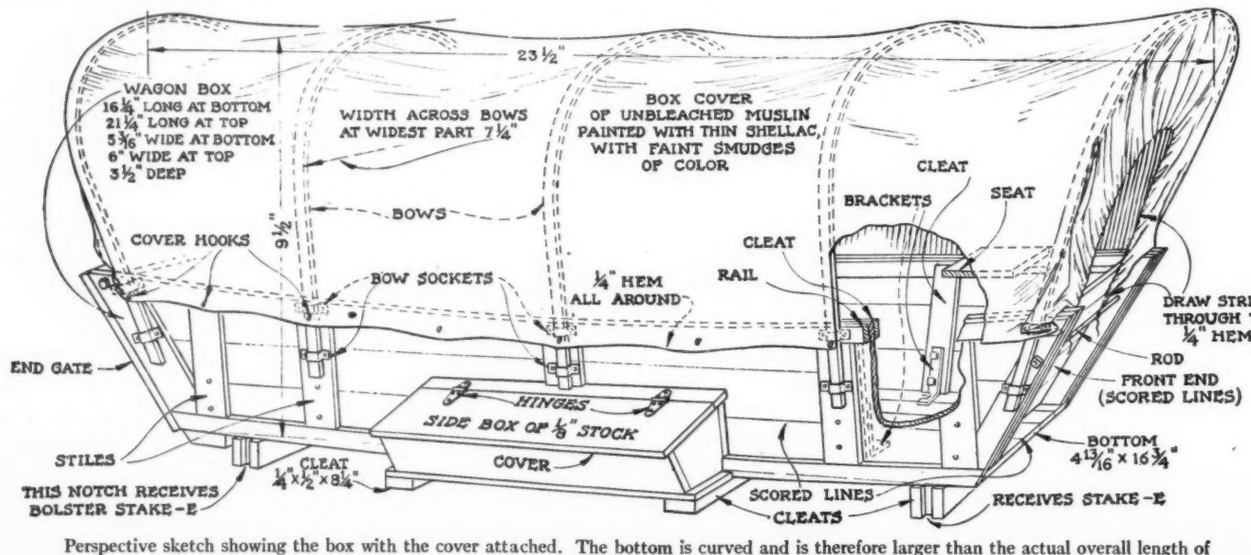
Base: The writer cut a rectangle of Tabasco mahogany, ¾ by 9¾ by 24 in., rounded the edges, applied Bismarck brown water stain, and sanded it lightly to remove any raised grain. No filler was used, but a coat of wax was well rubbed in.

Lay the tongue on the base lengthwise, with the yoke diagonally over it, under the front wheels.

Bore a ⅜-in. diameter hardwood dowel with a ¼-in. bit, and cut off four ⅜-in. lengths, to be glued over the spindles, inside the hubs, for nuts. Paint these black.

Tie a piece of brown string to the brake lever and tuck the other end in the front opening of the canvas cover.

Note: Several readers have inquired whether oxen can be purchased for the model. If a sufficient number wish to obtain them, Mr. Love is willing to carve the models and make the casts, prorating the cost. Write to Mr. Love, in care of this magazine, and indicate whether you desire 13-in. oxen for a 24-in. wagon, 9-in. oxen for an 18-in. wagon, or 6½-in. oxen for a 12-in. wagon.



Perspective sketch showing the box with the cover attached. The bottom is curved and is therefore larger than the actual overall length of the box indicated. Full size drawings can be obtained by sending seventy-five cents for Blueprints Nos. 118, 119, and 120 (see page 103).

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Foot-Controlled Bench Lathe

A Novel Way to Arrange a Friction Disk Drive—Gives Wide Range of Speeds and Is Reversible

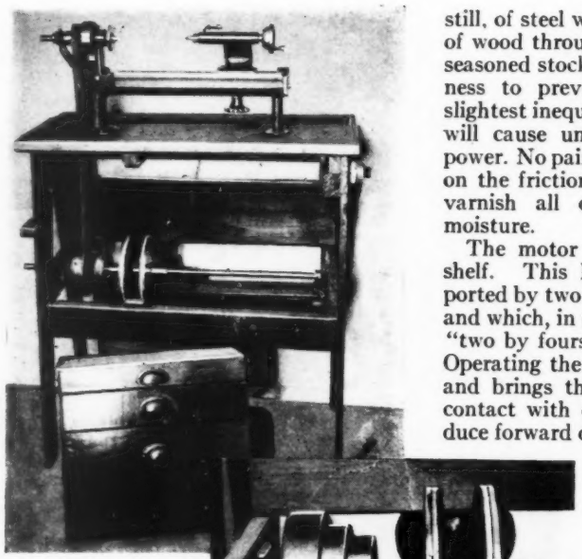
By WARREN N. CRANE

SINCE a lathe is, without doubt, the most important and in many cases the only power-driven machine in the home workshop, the problem of mounting it properly and providing it with a convenient drive is one that deserves careful study.

An effort to discover an ideal arrangement for a small lathe resulted in the bench illustrated. Being the outgrowth of many experiments and having given good service for years, the design may help other amateur mechanics, especially model makers, to build lathe benches of the utmost efficiency and convenience.

The motor is started without load, the speed is adjustable, and the reversible drive, which is by friction disks, is foot controlled and requires only one shaft, two bearings, and a belt. The advantage of a friction drive is the ease with which slow speed and low power can be obtained when necessary for delicate turning, magnet winding, and the like.

The bench was made up of such odds and ends of lumber as may be found in and around any home shop. The top is covered with battleship linoleum and edged with running-board molding such as is used on automobiles. The cabinet of drawers is made as a separate unit so that it can be removed easily when necessary to inspect, adjust, or oil the bearings. In the drawings below only the general dimensions are given because the type of lathe and motor will govern the exact sizes and design to a large extent.



The bench table with the tool cabinet removed to allow the main shaft to be seen clearly.

A close-up of the cone pulley and the friction disks with the motor directly behind them.

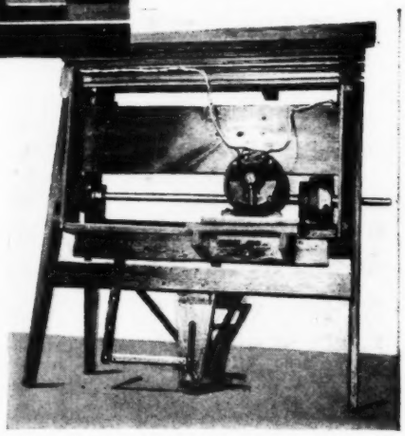
The unique feature is the arrangement of the friction drive. The main shaft, which carries the large cone pulley and the friction disks, runs in ball bearings to reduce the power loss, since no one wishes to buy a motor any larger than is necessary.

Many expedients were tried before a thoroughly satisfactory friction gear was developed, and it is perhaps inadvisable, at least for the beginner, to try to modify the one shown in any essentials. It is made as follows:

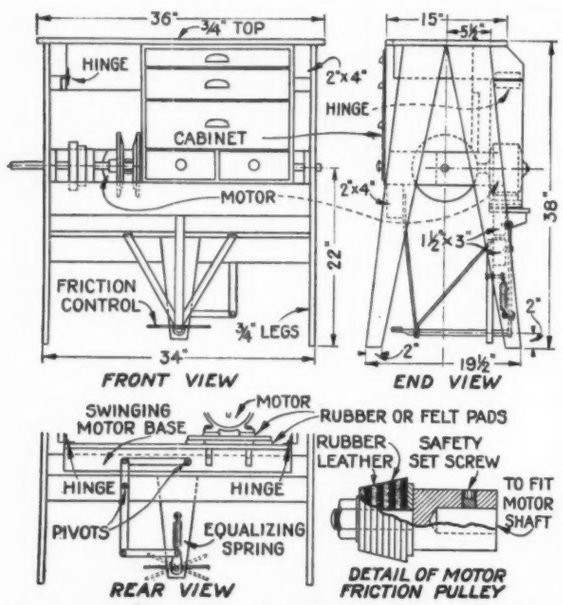
A hub or core is prepared as shown in the drawing marked "detail of motor friction pulley." Washers of leather and rubber (a good quality suitable for packing should be used) are strung alternately on the spindle and turned down to the required size and taper after being clamped tightly in place with a nut and washer.

Next, the large disks are made of wood or, better still, of steel with a wood facing. If made of wood throughout, use only thoroughly seasoned stock at least three-ply in thickness to prevent warping, because the slightest inequality in the friction surfaces will cause uneven running and loss of power. No paint or varnish should be used on the friction surfaces, but it is well to varnish all other parts to keep out moisture.

The motor is fastened to a swinging shelf. This long, narrow shelf is supported by two boards to which it is hinged and which, in their turn, are hinged to the "two by fours" at the top of the bench. Operating the foot pedal swings the shelf and brings the motor friction pulley in contact with either friction disk to produce forward or reverse motion. The foot pedal and the connections are made as illustrated. The equalizing spring is placed in such a position as to hold the motor in its central position with the friction pulley touching neither disk.



The rear view of the bench. Note particularly the swinging motor shelf and its support.



Three views of the bench as built by Mr. Crane and a detail of the combination rubber and leather pulley used on the motor shaft.

To reduce noise, the motor is supported on rubber or felt pads on a sub-base, which in turn rests upon pads of the same material.

In wiring the outfit, it will be found convenient to include an outlet with a plug receptacle or two for a droplight and a small motor grinder or an electric soldering iron. It is also well to use a longer main shaft than is actually required, for the time may come when some other light machine or piece of apparatus can be driven from this shaft extension.

The cabinet is not essential, but is a genuine convenience.

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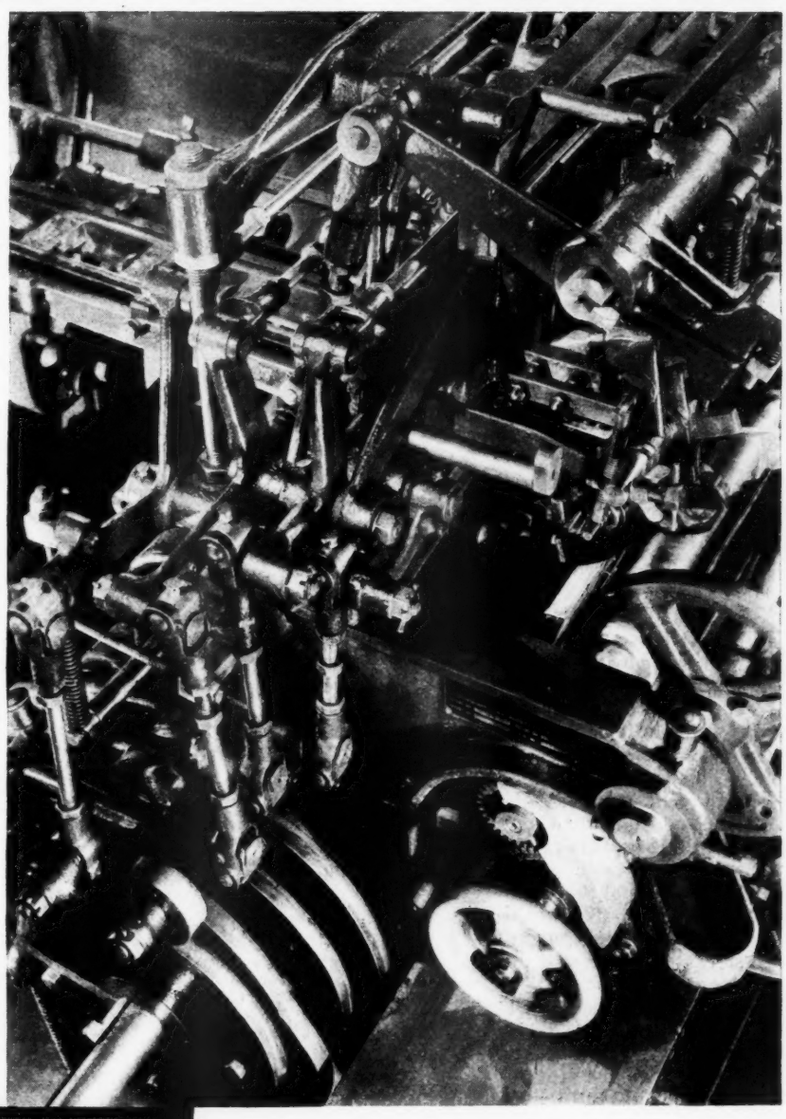

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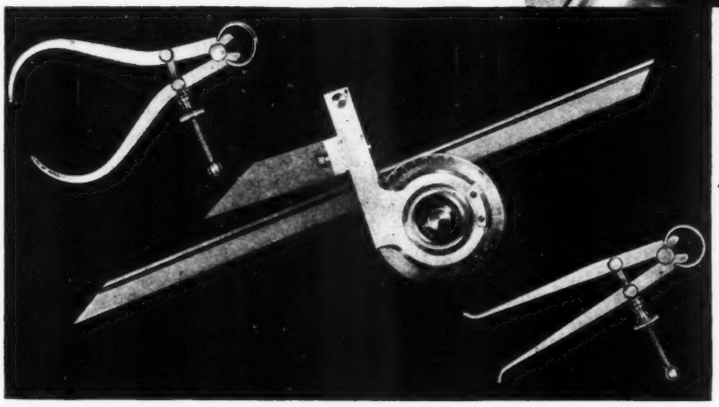

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Threading Facts for Shop Men

Materials to use for nuts—The designing of differential screws—How to relieve friction—Making a loose nut fit, and other hints

By HENRY SIMON

Shop men who realize the importance of threading operations study each problem and the use to which each thread is to be put before they begin the work.

THERE are a great many things to consider in the choice of metal in threaded parts subjected to wear.

A good rule to follow in all thread work is to have a marked difference between the hardness of the nut and stud. This is usually accomplished by using different metals; as, for instance, cast iron or bronze for the nut and steel for the stud. Mistakes are frequent when both parts are made of steel. Fig. 1 shows the principal right and wrong combinations. A soft-steel nut is no running mate for a soft-steel stud, while a hardened steel stud works well with a soft nut, and vice versa.

Where it is necessary for both parts to be of steel and also to be hardened, the temper of one should be drawn appreciably more than the other. This, by the way, is a good rule to remember for any and all parts subject to more or less constant wear.

Figure 2 illustrates several different methods for taking up play in nuts. A serviceable way for ordinary purposes is that shown at *A*, in which the nut is slotted parallel to its end faces and then sprung together slightly. Another good plan, but one unsuitable for nuts subjected to any considerable stress, is the splitting method shown at *B*. Either *A* or *B* are suitable for nuts which must be adjusted frequently. This is not true, however, of the expedient of setting the nut up under pressure as indicated at *C*.

A better variation of the same procedure is to set up or slightly crush the end threads as at *D*, as this does not deform the remainder of the nut. About the poorest way is that of ovaling the nut as at *E*, which makes the threads engage only at two opposite points. A method of taking out the play by means of solder, sometimes useful with hardened nuts, is illustrated at *F*.

It should be observed that none of these measures is of the nut lock variety, it being no part of the author's aim to add anything to the information contained in something like 4,000 patents issued on nut-locking devices.

There is a good deal in knowing how to make threads engage and fit, but there is as much in knowing how to use and apply them properly for special purposes. Regular hexagon cap screws are frequently used for adjustment in shopmade fixtures, but attention is rarely paid to a logical relation between the pitch of the thread and the hexagon. It costs nothing to do this right and it saves a great deal of guesswork and figuring later (see Fig. 3). Standard V-form threads of 14 and 28 threads per inch are suitable for hexagon division, because they give results for each sixth turn in round thousandths, as is seen at *A*.

The situation is a different one where a closer adjustment is to be obtained by the use of a round dial-type head instead of a hexagon. In this case, everything should be divisible by 10 to give whole thousandths. Screws having 10 and 20 threads per inch are the only ones that will give these results, as shown at *B*, unless it is desired to go down as fine as 40 threads per inch, which ordinarily is not advisable.

With Fig. 4, we enter the Chinese puzzle section of helicosophy. Differential threads are to screws what planetary drives are to gearing, and it is partly due to this fact that their very valuable properties are not more frequently taken advantage of. Of many possibilities, only a few of the most promising can be discussed here. A differential thread must always be comprised of at least four elements, namely two male and two female threads, but these may be combined and arranged in any one of a great number of ways to give a variety of different results.

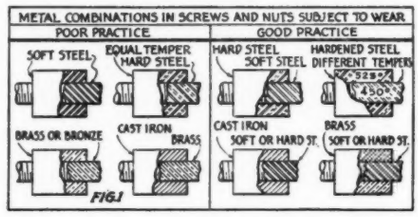
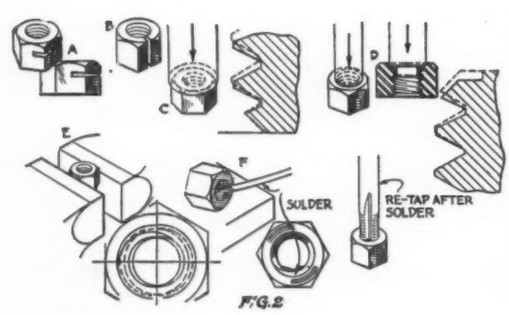


Fig. 1. Success in threading often depends on the proper choice of material for the nut.

At *A*, in Fig. 4, the two male threads are fixed relative to each other, both being on the screw *c*. Of the two nuts, either *a* or *b* may be stationary or fixed, the resulting movements in both cases being shown at *B* and *C* respectively. *D* and *E* illustrate variations of the same plan involving a right- and left-hand thread. In Fig. 5, the male threads are on different studs, of which one forms the nut for the other as at *A*. It is of course necessary to prevent part *b* from rotating, which may be done by slabbing it as shown. In *B*, the shank of one screw slides in the other, while the second is prevented from revolving relative to the first.

Differential threads are highly useful, particularly in obtaining extremely fine movements with ordinary coarse threads, and in causing simultaneous differential movements of two parts. A practical example of the first kind is that shown at *C*, illustrating the device at *A*, where by the use of a 16- and 18-per-inch thread we obtain the extremely fine advance of 0.007 in. for each revolution of the larger screw. Such a result would be out of the



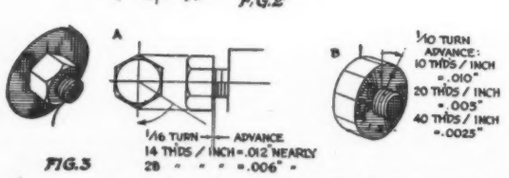
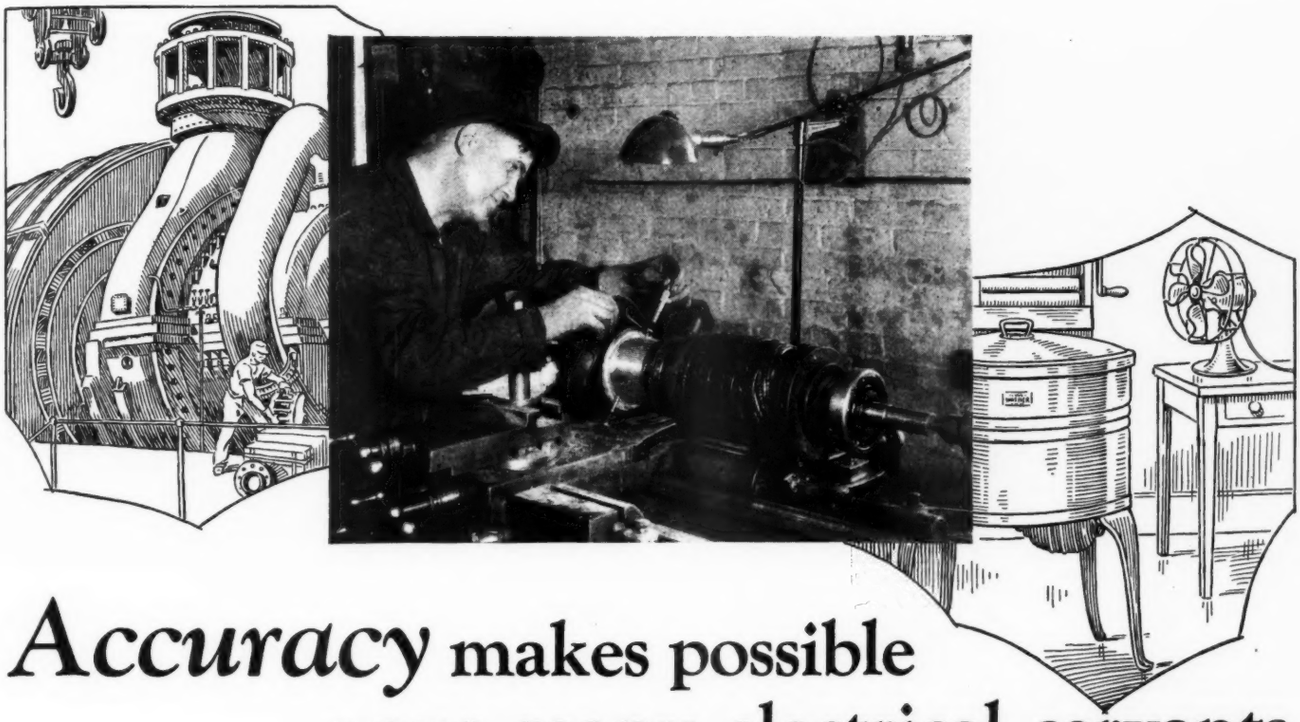


Fig. 2. How to make a loose nut fit. Fig. 3. Using regular hexagon cap screws for adjustments in shopmade fixtures.



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question altogether with any standard single thread, for it would call for 143 threads per inch, a condition that would be highly impractical. It is well to bear in mind that although theoretically differential threads can be used to obtain a tremendous leverage, the large frictional factor practically neutralizes any benefit derived from that quality. Differential threads should therefore not be used for obtaining higher pressures.

Let us conclude with a few random applications of threads. At *A*, Fig. 6, a tap has been used to relieve friction and provide oil space for a sliding rod placed in a long bore. An analogous use of a tap is that shown at *B*, occasionally used in connection with a driving fit to provide a series of relief spaces for the compressed metal. The makeshift worm movement illustrated at *C* can be improvised from a fiber wheel and a threaded stud, the center distances being so related as to force the thread partly into the fiber and make it cut its own thread. *D* shows how a small but powerful jack can be made from a cap screw and nut by placing a steel ball in the screw head. Finally, *E* illustrates the fact that a screw is the simplest of all racks for use with a small ratchet pawl.

In his next article, Mr. Simon will describe various methods of perforating thin metal.

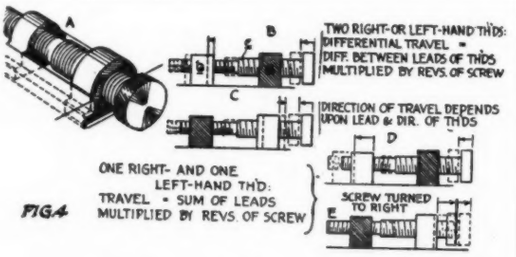

TWO RIGHT-OR LEFT-HAND THDS: DIFFERENTIAL TRAVEL = DIFF. BETWEEN LEADS OF THDS MULTIPLIED BY REVS. OF SCREW
DIRECTION OF TRAVEL DEPENDS UPON LEAD & DIR. OF THDS
ONE RIGHT- AND ONE LEFT-HAND THD: TRAVEL = SUM OF LEADS MULTIPLIED BY REVS. OF SCREW
SCREW TURNED TO RIGHT
FIG.4

Fig. 4. All differential threads are composed of at least two male and two female threads, arranged in any one of a number of ways.

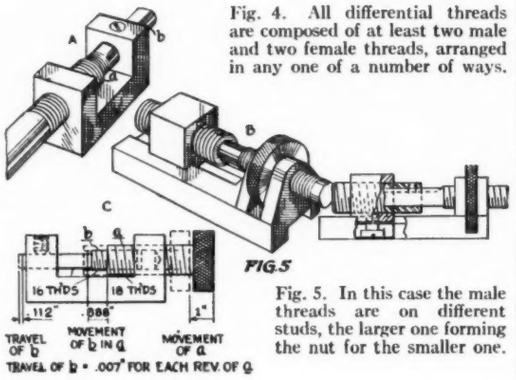


Fig. 5. In this case the male threads are on different studs, the larger one forming the nut for the smaller one.

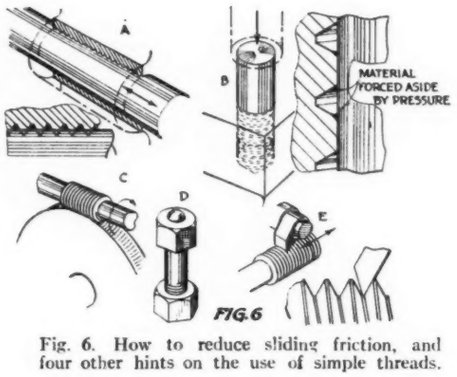
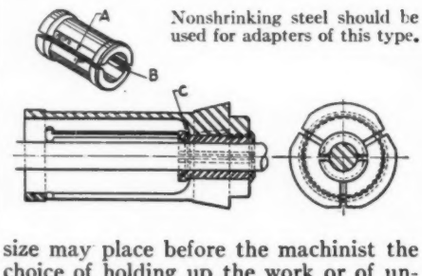


Fig. 6. How to reduce sliding friction, and four other hints on the use of simple threads.

How to Make a Simple Collet Adapter

IN ANY machine shop, whether large or small, collet adapters like those shown below will be found to be a time-saving addition to the tool crib. With the many sizes of stock extant, it is quite expensive to equip a lathe or screw machine with a full set of collets; yet, on the other hand, the lack of some one single size may place before the machinist the choice of holding up the work or of undertaking the rather expensive task of making a special collet.



Nonshrinking steel should be used for adapters of this type.

Adapters of the type illustrated were tested out by the writer on many thousands of screw products and they have proved to be satisfactory in every way. They are so simple in construction and contain so little metal that very little time and expense are required in making them. If two or three of the largest bore collets are on hand, any of the smaller stock sizes can then be taken care of.

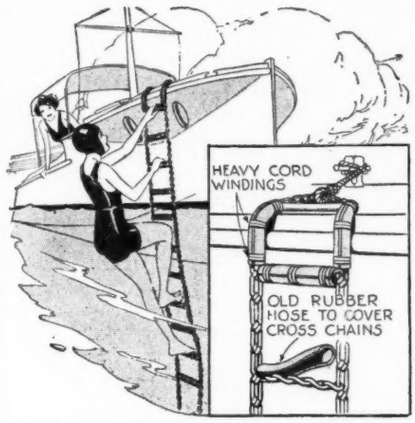
The adapter consists merely of a two-part split sleeve which fits the bore of the collet, and is provided with a low shoulder at either end. Good gripping and releasing action of the collet on the adapter and the adapter on the stock is insured by flats which are filed on the outer contact surface at *A* and bevels which are placed on the internal edges of the two halves as at *B*.

The saw used in cutting the sleeve in half should be as narrow as possible, in order that the two halves will not close to too great an extent when no stock is in the adapter. It is important to leave a little end play, say a small 1/32 in., at *C* so as to prevent any binding of the collet endwise. It is also a good plan to make the outside adapter diameter about .001 in. larger at the front end so as to have the maximum gripping action where it is most desired.

Adapters of this kind should always be made from nonshrinking steel, and drawn to a deep straw color.—H. S.

SWIMMER'S LADDER MADE FROM TIRE CHAINS

TO ENJOY swimming from a house boat or yacht, it is necessary to have some sort of ladder upon which to climb aboard. Such a ladder can be made at trifling expense from discarded tire chains from which every other cross chain or every two out of three cross chains are removed. The remaining cross chains, which form the "steps," are covered with lengths of old garden hose. The rubber



Lengths of old rubber garden hose or brass pipe can be used to cover the short cross chains.

may be split, slipped over the links, and bound securely with heavy cord as shown, or a link in each cross chain may be opened and the hose—or lengths of brass pipe, if preferred—slipped on and the link refastened. The chain should be given a coat of red lead and one or more coats of white paint to prevent rusting and to improve its appearance.

Hose placed over the upper ends of the side chains will protect the boat.

Because of its weight, this ladder hangs straight down into the water and therefore affords a secure footing. One marked advantage is that it can be stored away in a very small space—J.D.G.

POLISHING HEAD USED AS SMALL LATHE

WHEN a lathe is not available, small wooden articles can be turned successfully on an ordinary polishing head. The work is mounted by drilling a carefully centered hole in it and screwing it on the tapered end of the polishing-head spindle—the end on which buffing wheels usually are fastened. The grinding wheel on the other end of the spindle is not disturbed.

By mounting the work in this way and improvising a tool rest, I have turned articles up to 5 in. long and between 3 and 4 in. thick, as well as some pieces of walnut and maple overlay ¼ in. thick and 8 in. square. I have found that a speed of about 2,500 R.P.M. is the best to use. Small bottles and vases can be turned without difficulty because it is easy to shape their inside and end surfaces.—WENDELL M. CALDWELL.

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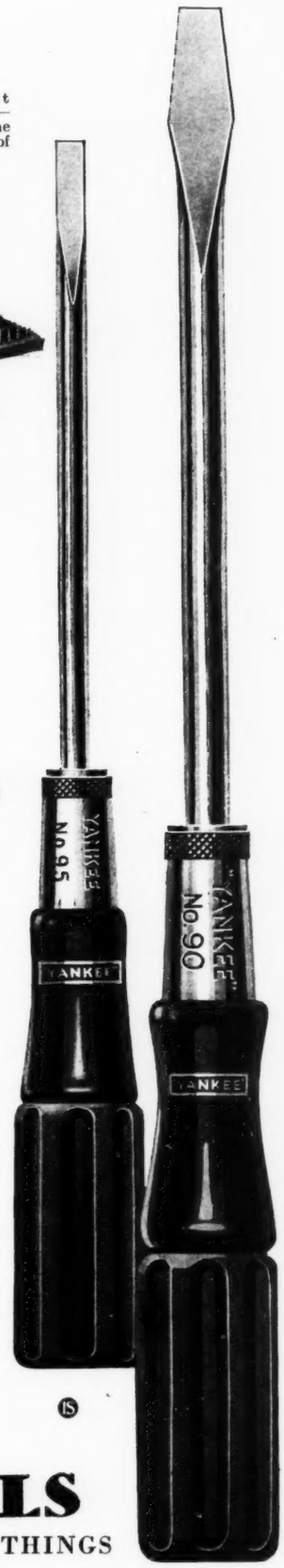

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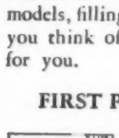

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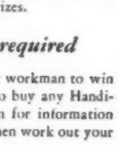

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Give Your Model Plane

The Right Propeller

By EDWIN T. HAMILTON

THIS is the first of a series of articles by Mr. Hamilton, who is not only an expert on model airplane construction and a well-known writer, but also an aviator of long experience. Although an American citizen, he served as an officer in the Royal Air Force all through the war, and he has been flying ever since. Two years ago he became interested in model making and since has risen to a high rank among authorities in this field.

After the blank has been cut to the general shape, it should be tested with a square.

THE heart of a model airplane is its propeller. No matter how aerodynamically perfect in design, how light in weight, however skillful in construction, or how beautiful in workmanship or finish a model may be, its propeller is the all-important detail, which will spell its success or failure when launched.

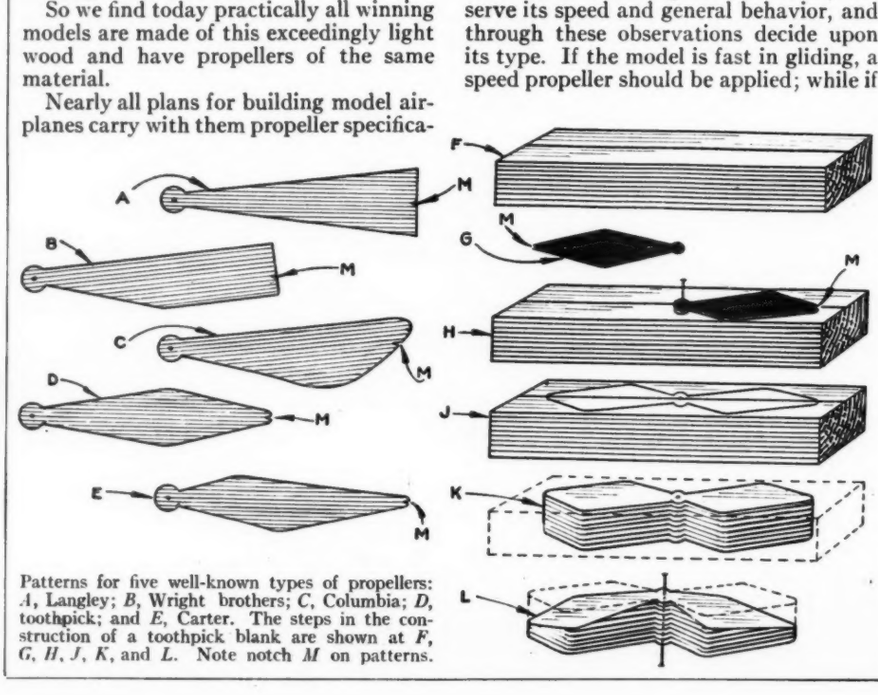
If a model is carefully tested, without power, in respect to its gliding ability and is found to maintain a long, smooth glide, it will fly well provided the correct propeller and motor are applied. If such a model should fail in flight, it will not be the fault of the model, but the fault of its propeller.

The first step in propeller construction is to choose the proper materials. A few years ago such woods as mahogany, pine, fir, spruce, whitewood, birch, basswood, and poplar were used for models and their propellers, but with the advent of balsa wood for speed and endurance models, all heavier woods for propellers soon fell into disfavor. This was due to the fact that the old propellers, made of heavy wood, weighed too much for balsa-built models, making them nose-heavy.

So we find today practically all winning models are made of this exceedingly light wood and have propellers of the same material.

Nearly all plans for building model airplanes carry with them propeller specifications. The model maker, using such plans, will do well to follow these dimensions, for it is assumed that they have been thoroughly tested by the designer and found best for the model in question. But where the model under construction is of an original design, the builder must determine for himself the best size for his model.

Before it is possible to decide upon the size, the builder must first know whether his model is a speed or endurance flyer. Some builders have found that their speed models are much better endurance flyers, and vice versa. With this in mind, the builder should glide his model, observe its speed and general behavior, and through these observations decide upon its type. If the model is fast in gliding, a speed propeller should be applied; while if



Patterns for five well-known types of propellers: *A*, Langley; *B*, Wright brothers; *C*, Columbia; *D*, toothpick; and *E*, Carter. The steps in the construction of a toothpick blank are shown at *F*, *G*, *H*, *J*, *K*, and *L*. Note notch *M* on patterns.

it maintains a slow, steady glide, an endurance propeller is indicated.

Diameters of propellers range from one fifth to one half of the wing span of the model, and the writer can find no set rule or formula to cover this problem. Builders can, however, follow as closely as possible the dimensions used on record breaking and prize winning models, which are invariably far above the average in efficiency.

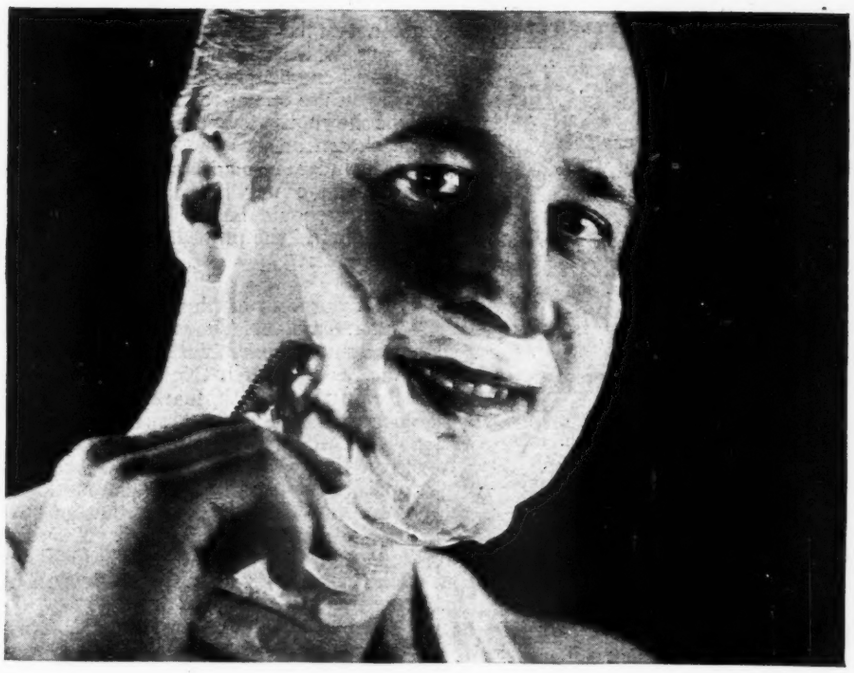
TO HELP the builder in this decision, a number of national winners are described in the tabulation shown on the following page, with their general characteristics and the dimensions of their propellers. These planes cover the field of popular models and can be safely followed as to their relative dimensions.

After determining material, type, and approximate size, the builder must decide upon his design. For a speed propeller, thin, tapered, medium pitch blades are correct, as such a design allows the rubber motor to unwind at great speed and gives faster revolution. If an endurance propeller is desired, wide blades are best, as these cause the motor to unwind slowly and prolong the flight. Indeed, it is well to have the blades too wide at first and then cut them narrower little by little after each trial until the propeller will sustain the model with the least number of revolutions per minute.

As a guide for the model maker, the five most popular propeller designs are illustrated on the preceding page. The Langley, named after its famous designer and by far the most widely used in model work today, is shown at *A*. It gives splendid performance and is the easiest to carve. *B* is the propeller used and designed by the Wright brothers on their early planes; it is quite similar to the Langley propeller, except that one side has been cut off. *C* is the Columbia, which is usually found on commercial models. The propeller is practically a Wright with its corners rounded. The "toothpick" is shown at *D*. Named after its shape, it is one of the finest of speed propellers known today. *E* is the Carter type, which is also a speed propeller of note. There are many more propeller designs, and experienced model makers should take the time to try out original designs, because the field is rich for experimentation.

IN CHOOSING the propeller blank, take care to obtain wood free from all checks and cross-grain, as the strain of the tightly wound motor necessitates uniform strength. It must be remembered that the chief asset of balsa is its light weight; and although it can be obtained in varying strengths, the harder the texture, the heavier the wood. Too hard a texture is undesirable, as its weight might be excessive. A medium texture, lightweight balsa will be found best for propellers.

Many model makers prefer to true up their blanks to exact size before cutting, but with the template method, described here, this step is not necessary. Merely smooth one face of the block with sandpaper and draw a line the length of the block on this face, as shown at *F*. Now



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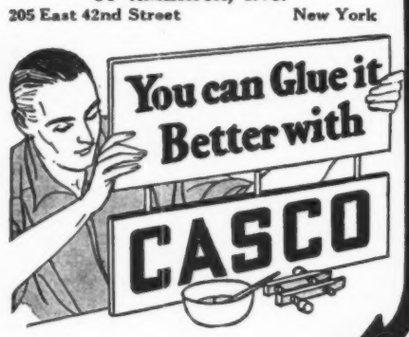

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cut a template from cardboard, tin, or copper, which will include the complete hub and one blade of the form desired.

If you use one of the five propeller designs shown, the template should look like the chosen one, as the drawing in each case includes one blade and the entire hub. From the center hole to the tip, the template should be the exact length of the radius of the propeller or one half of its diameter.

FOR purposes of illustration, a toothpick template is shown at *G*. It should have a small notch *M* cut in the end of the blade, as indicated. Now lay the template on the smooth, marked face of the block and stick a pin through the center hole, so that it enters the block on the drawn line, as shown at *H*. Place the notch at the end of the template exactly on the line and trace the outline of the blade on the block. Without removing the center pin, swing the template around until the notch is again on the line; then trace the other blade, as at *J*.

The block is now cut out as at *K*. This work can be done with a coping saw or a sharp knife. When the excess wood has been removed to the line, see that the cut sides are at right angles with the smooth face by running a try-square around them. Smooth with fine sandpaper.

The blank is now tested on the opposite face with the template. Lay the template on the face, pin the center as before, and see that the cutting has been true. As we are using the toothpick propeller, the blank is next tapered, as shown at *L*. This treatment produces one of the best speed propellers. If an endurance propeller is desired, the blank is not tapered.

The hub hole is now made. Balsa is so soft that a common pin can be pushed through the center of the hub. It is most convenient to use a T-head bank pin, if available. The hole must be perfectly straight and at right angles to the face of the propeller. Pushing the pin halfway through the hub from both sides as at *L* will help in obtaining accuracy.

The blank is now ready to be cut. A sharp knife is the popular instrument for this work, although the writer prefers using a wood carver's gouge with a ¾-in. blade, slightly curved. However, if this gouge is used, care must be taken not to cut too deep.

As the actual cutting of propellers has been covered so many times, each step in the operation will not be dealt with here, but a few major points will be given to help the beginner.

Always cut from the upper edge down to the opposite lower edge. When the blades are about 1/16 in. thick, discontinue the use of the knife and finish with sandpaper. Shape the face of each blade so as to have a 1/32 in. deep concave form, which can be easily measured with a steel rule laid across the face. This curvature, or camber, can be best obtained by using sandpaper wrapped around a curved piece of wood or a round file. When the concave faces are completed, turn the propeller over and sandpaper the convex faces to correspond. The outer two thirds of each blade should be sandpapered until it is thin enough to allow light to penetrate. Both blades must be exactly alike so that the propeller balances perfectly.

MANY championship models have propellers with hubs only ⅛ in. thick, and as this section of the propeller is the most inefficient, it can be safely cut away. At the same time, care must be taken not to cut the hub too thin, as it must be left strong enough to stand considerable strain.

The hub and blade tips may be coated once with an ambroid type of cement to guard against breaking, or the tips may be covered on one side only with Japanese silk, held tightly in place with dope.

The shaft of the propeller is next passed through the hole made in the hub by the template pin. Test with a square while doing this to insure the perpendicularity of the shaft to the hub.

When the shaft has been passed through the hub and before it is cemented, revolve it several times to make sure that it is true with respect to the propeller.

The next article in this series will describe the cutting of a true pitch propeller.

Propellers Used on Prize Winning Models

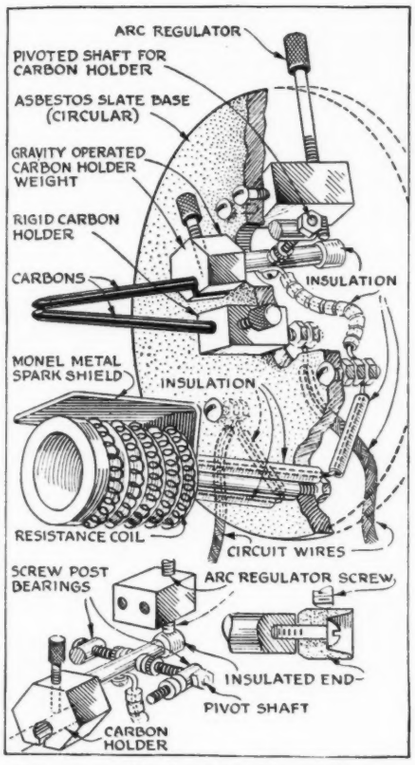
Types and Remarks	Wing Span	Fuselage	Propeller Blank
Twin-Stick Pushers:			
16 M.P.H.	18	32	¾x1 x 7½
17 M.P.H.	20	28	¾x1⅛x 5½
Won at National Air Races, Philadelphia	25½	38	¾x1 x 8½
Flew 5½ min.	32	39½	1 x1½x12
Flew out of sight at National Air Races	35	40	1 x1¼x11
Won N.P.M.A. meet, Memphis, 1927; Mulvihill award at Philadelphia	35½	40	⅞x1¼x10½
Single-Stick Pushers:			
With 2 propellers; flew 2,000 ft.	24	36	¾x1 x 8
	16½	15	¾x1⅛x 7
Outdoor Tractors:			
Flew 5,110 ft.; duration 427 sec.	40	46	1 x1 x11
With 2 propellers; flew 40 M.P.H.	26	30	¾x ⅞x 9
Indoor Tractors:			
Flew 2 min. 9.6 sec.	19	18	¾x1¼x10
Made world's record of 207 sec.	19	15	11/16x1¼x10

All dimensions are in inches.

Carbon Holder for Ray Experiments

ELECTRICAL experimenters who are studying ultra-violet rays or who wish to construct an inexpensive arc lamp for photographic or other purposes will find many interesting features in the simple and efficient carbon holder illustrated.

The movable holder is operated by gravity; and because of the fact that it is impossible to bring the carbons together

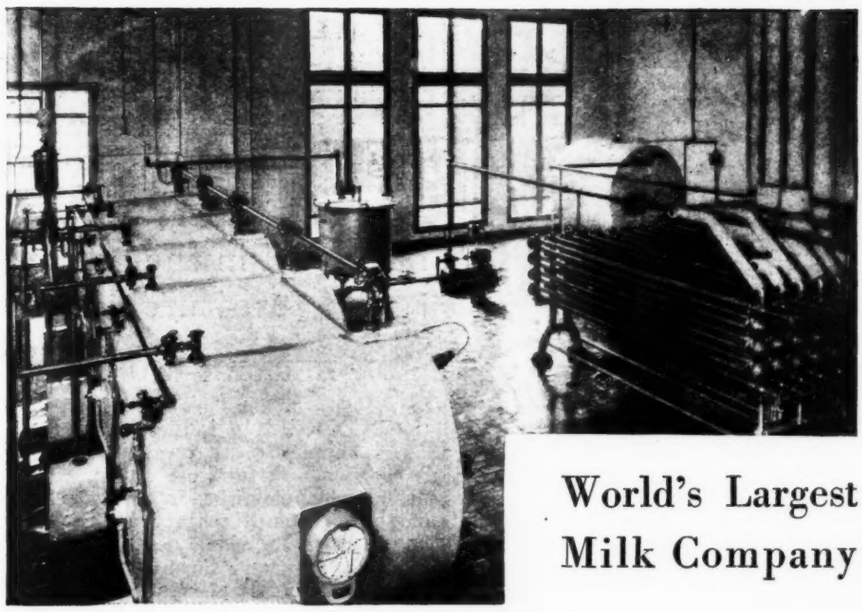


The upper carbon is regulated by an adjusting screw while the lower carbon is stationary.

with any pressure other than the force of gravity can supply, it is impossible to break the carbons by excessive feed. The angular contact of the carbons makes them semiautomatic, since they will burn halfway down before the arc will break. The adjusting screw is well insulated and can therefore be handled while the lamp is in use. The resistance, which can be a heater unit, should be wound, to give about 16 ohms resistance.

When used with ordinary carbons, the lamp performs admirably for all photographic work, and if the ultra-violet carbons are substituted it can be used for the treating of cereals and other foods

Of course, this holder, if mounted on a suitable reflector, also can be used for the administration of sun baths, but this should be attempted only under the personal supervision of a physician. Baths administered without proper supervision may prove extremely dangerous, because very severe burns can be caused by overexposure. The danger is all the greater because of the tendency of the patient to fall asleep.—EDWARD SCHULTZ.



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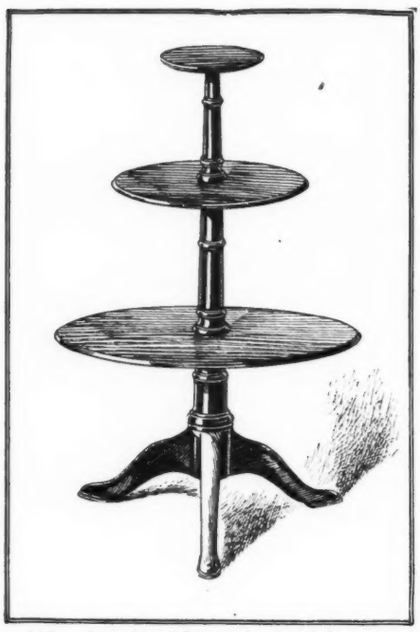
A Rarity Among Tables

How to make a copy of a "dumb-waiter" stand fashioned in the golden age of furniture design

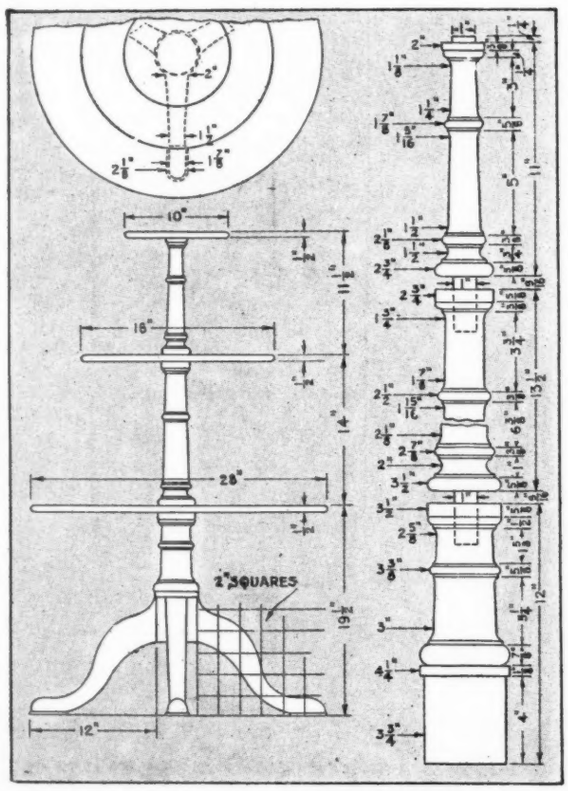
By HERMAN HJORTH



Although designed for use in the dining room, it may be used as a tea table or curio stand.

"GEORGIAN" is the term usually applied to what was the "golden era" of furniture design. This period, which flourished in the latter half of the eighteenth century and is also known as the Individual period, the Neo-Classic period, and the Second Renaissance, embraces the greatest names in the history of furniture—Chippendale, Adam, Hepplewhite, and Sheraton.

The dumb-waiter table illustrated is characteristic of the Georgian master craftsmen. It was originally designed as a piece of dining room furniture, but may be used as a tea table or for the display of curios and bric-a-brac. Modern adaptations are about 30 in. high and, since they serve mainly as end tables or coffee tables, they are sometimes made with only two tiers. The genuine antiques, however, have three or four tiers. The retail price of a commercial table of similar design in a New York department store is $190. The cost of the materials, if birch or maple is used, will not be in excess of $4.50.



Dimensioned drawing of the assembled table and detail showing the construction of the column. The legs are placed 120° apart.

The turned column is made in three parts as shown in the detail below. The hole in the upper end of the two lower pieces must be bored first. The best way to do this is to center the piece as for ordinary spindle turning; then remove it and fasten a bit in a drill chuck, fitting into the tailstock. The section to be bored is then driven on the live center; and the bit is brought in contact with the end, so that the spur or point enters the depression made by the dead center. The lathe is now revolved by hand while the handwheel on the tailstock is turned, thereby forcing the bit gradually into the wood. The hole also may be bored with an ordinary bit and brace, if the work is carefully done.

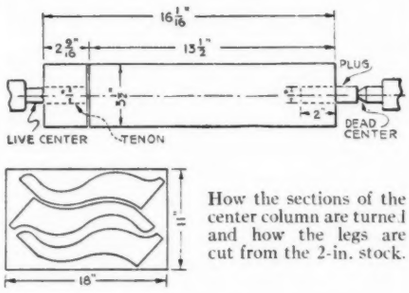
A plug is now turned to fit the hole. It should project about 1 in. beyond the end of the piece, so that it can be extracted. The end of the plug marked by the dead center should again run on the dead center after it is inserted. In this way the hole bored in the stock will be accurately centered. The turning is now done according to the detail drawing, and a tenon is turned on the live spindle end. The tenon should fit snugly into the hole bored in the lower section of the column, and it should be long enough to leave a

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

space of 9/16 in. between the two sections of the column. The upper section has no hole, but a tenon on each end.

If a piece of cardboard is ruled off in 2-in. squares, as suggested on the drawing, the outline of the leg may be easily transferred. Allow at least ½ in. on the end of each that is to fit against the column. Place the pattern on a 2-in. plank in such a way that the legs are cut the long way of the grain (see illustration below).

The easiest way to fit the legs to the column is by means of dowels. First, sandpaper the end of each leg hollow so that it will fit snugly against the column. This can be done easily by turning a cylinder 3 in. in diameter and gluing a piece of sandpaper to it. Steady the leg on the T-rest and hold the end against the sanding cylinder until the desired curvature is obtained. The method of fitting the legs to the column, making the dowel joints, and gluing them was



How the sections of the center column are turned and how the legs are cut from the 2-in. stock.

fully explained and illustrated in a previous issue (P. S. M., July '28, p. 90).

When the dowel joints have been made, the legs should be shaped. This work is best done with a spokeshave, rasp, file, scrapers, and sandpaper. The legs are then glued in place, one at a time.

It is best to make the shelves or trays of well-seasoned plywood, ½ in. thick. A hole of slightly larger diameter than the tenons should be bored through the center and middle tray, so that they can be revolved. The upper one is glued to the end of the column.

It is not necessary to glue the three sections of the column together if the tenons fit snugly in the holes.

The shelves on antique dumb-waiter tables were made of solid mahogany and turned with a raised edge. This, however, can only be accomplished on a large lathe.

As to the selection of lumber, I suggest a hard, close-grained wood like birch or maple. Directions for finishing have been given repeatedly in past issues (P. S. M., Apr. '30, p.76; Feb. '30, p.88; Jan. '30, p.80, etc.).

List of Finished Parts

No. Pcs.	Part	T.	W.	L.
1	lower column	4¼	4¼	12
1	middle column	3½	3½	16 1/16
1	upper column	2¾	2¾	13 9/16
1	plank for legs	2	11	18
3	feet	¼	2⅛	3½
1	lower tray	½	28	28
1	middle tray	½	18	18
1	upper tray	½	10	10

All dimensions are inches.

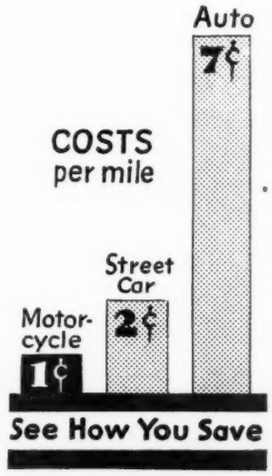
GREAT SPORT
-and it Saves Money!

RIDE a motorcycle—there's a thrill in every mile! Soar over hills like a swallow—swoop down the highway past the car parades — or just loaf along a country lane with your purring motor for company!

Ride away from the heat and the traffic. Get out into the country. Join the jolly Harley-Davidson bunch on their outings and tours. Feel the red blood race through your veins as your motorcycle leaps eagerly to your touch on the throttle.

Forget expense! You can travel by Harley-Davidson as cheaply as 1¢ per mile, including everything! And the motorcycle is easy to buy, too — your dealer offers a Pay-As-You-Ride Plan that will scarcely dent your pay checks!

Let your nearest dealer show you our Single and Twin models — priced from $260 up, f. o. b. factory.



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HARLEY-DAVIDSON MOTOR COMPANY
Dept. P. S., Milwaukee, Wis.
Interested in your motorcycles. Send literature.
Name.....
Address.....
My age is ☐ 16-19 years, ☐ 20-30 years, ☐ 31 years and up, ☐ under 16 years. Check your age group.

Check Fatigue at its Source

To maintain the speed and power you enjoy in a first fast set, check fatigue at its source. Adopt the rule of all athletes. Wear a supporter and fortify the vital . . . and least rugged . . . zone of your body against exhausting strains.

Pal **will serve as this unseen partner, anticipating and making safe every stroke you attempt. Protect the delicate cords and structures left unguarded by nature and you conserve the energy the game demands.**

Armored ribs of live rubber knit into *Pal's* exclusive texture give super-support yet conform to every motion without binding or chafing. Porous, cool, non-absorbent . . . soft as new after washing. Priced from $1.00 up, *Pal* outwears two or three ordinary supporters.

Bike **is the finest one-piece, all-elastic supporter made. Ingenious design doubles its strength and service. Easy to wash and wear. Easy to buy, too, at 50 cents and up. At all druggists and sporting goods dealers.**

Pal and BIKE

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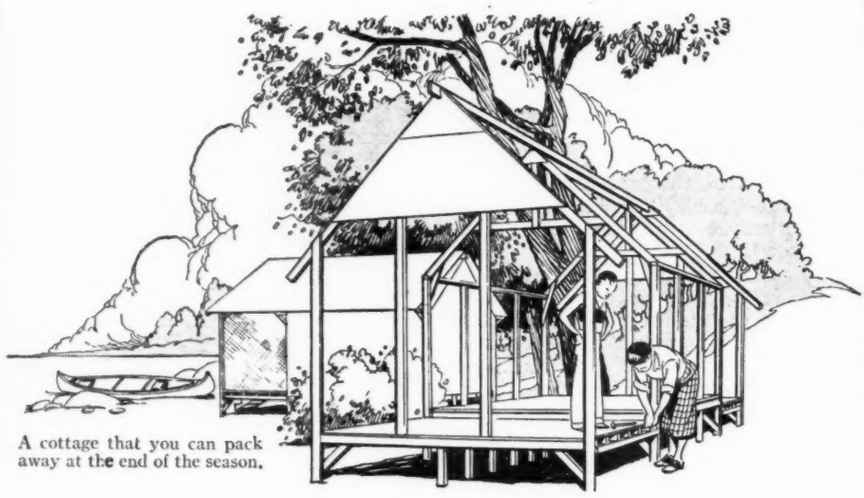


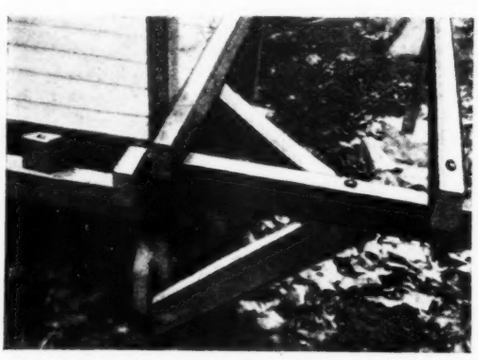
A cottage that you can pack away at the end of the season.

Setting Up a Substantial Canvas Cottage

JACK HAZZARD gives suggestions on the building of a tent framework and floor

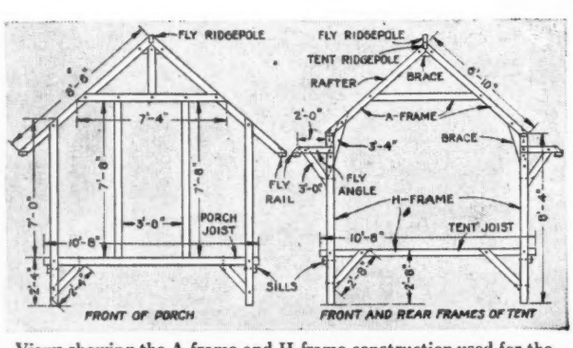
FOR a semi-permanent summer camp, it is hard to beat a really livable tent. A tent such as the one illustrated is stanch, weather-tight, and cool during the heat of the day and thoroughly comfortable at night.

Many families have bought or leased bits of ground at vacation spots miles away from home, where they must maintain some sort of shelter. The natural tendency is to erect a summer cabin costing anything from a few hundred to a few thousand dollars, but that is not always the wise thing to do. Those who do own summer cottages often find that winter ice, spring freshets, or the prying fingers of the beach comber have stripped them clean during the quiet season. A tent and its platform and framework are not subject to this damage, since they can be stored away between seasons.



Details showing how the corners where the tent and porch floor join are braced for additional strength.

The lumber for a canvas camp may cost as much as sixty dollars and the tent and fly fifty dollars, but the resulting satisfaction will well repay the builder. A unit such as described will shelter three or four persons comfortably, and one or more units can be added at will. The outfit is easy to knock down for storage, the frame serving for from six to ten seasons.



Views showing the A-frame and H-frame construction used for the tent and porch ends. Notice the bracing and the two fly rails.

Since the frame goes inside the tent, first measure the interior of the tent. These measurements must be accurate, as it is expensive to cut dressed two by fours by the trial and error method, although if an error does creep in there are numerous places where short lengths can be utilized. Set the tent up true and

(*Continued on page 104*)

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....
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102. Morris Seaplane (record flight 12½ min.)
104. Tractor (record flight 6,024 ft.)

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5. Kitchen Cabinet
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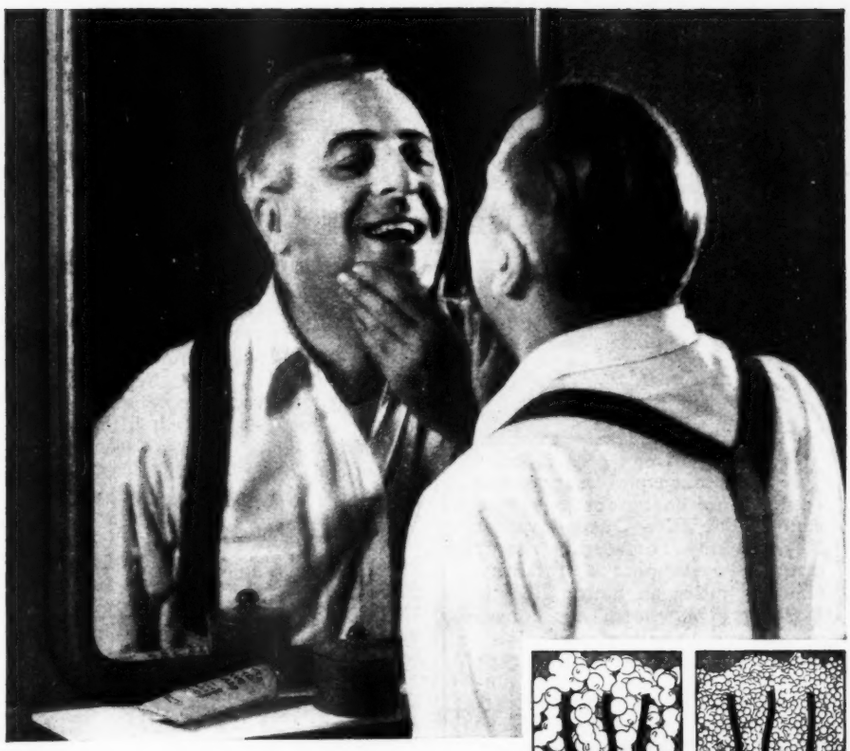


ORDINARY LATHER

This lather-picture (greatly magnified) of ordinary shaving cream shows how large, air-filled bubbles fail to get down to the base of the beard; and how they hold air, instead of water, against the whiskers.

COLGATE LATHER

This picture of Colgate lather shows how myriads of tiny, moisture-laden bubbles hold water not air, in direct contact with the base of the beard, thus softening every whisker right where the razor works.

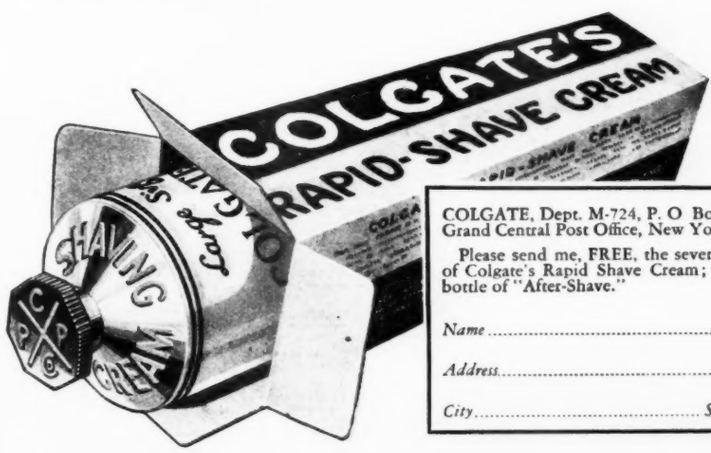
Longer-lasting Shaves
from small-bubble lather

Beard softened completely ...permitting a much closer, smoother shave.

RIGHT at the base of each hair—where the razor works—that's where the small bubbles of Colgate's take more moisture—unlike big, air-filled bubbles which can't get down. When you lather with Colgate's you can shave much closer than with ordinary lather—hence a Colgate shave lasts longer.

The minute you lather up with Colgate's two things happen: 1—The soap in the lather breaks up the oil film that covers each hair. 2—Billions of tiny, moisture-laden bubbles seep down through your beard...crowd around each whisker... soak it soft with water.

A comparative test is easy—just mail the coupon, now. We will send, also, a sample of After-Shave, a new lotion... refreshing, delightful...the perfect shave finale.



COLGATE, Dept. M-724, P. O Box 375
Grand Central Post Office, New York City

Please send me, FREE, the seven-day trial tube of Colgate's Rapid Shave Cream; also a sample bottle of "After-Shave."

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NOW, at moderate expenditure, you can own a smart runabout equal in speed and comfort to boats costing thousands. The Elto Quad develops 35 horsepower, drives big roomy outboard runabouts 30 thrilling, slashing miles an hour. Electric starting gives motor car convenience and handling ease. Four-cylinder design with new type rotary disc valves and new underwater silencer give velvet-smooth, quiet operation.

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New Elto catalog completely describes new 1930 models—the Quad, Senior Speedster, Service Speedster and the handy folding Lightweight. Mailed free.

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The conventional muffler, so practical on outboard motors in the smaller sizes, is no longer employed on the higher powered models of Elto, Lockwood and Evinrude manufacture. Underwater Silencers transform former deafening exhaust noises into a soft drone, without loss of power. Gone, too, are exhaust fumes—washed away in the foaming wake.

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FOLD-LIGHT! It f-o-l-d-s to only 11¼ x 13¾ x 17 inches—stow it anywhere like a traveling bag. It's light — carry it anywhere; only 29 pounds. It's powerful — full 2¾ horse power, getting *efficient* speed from canoes, rowboats, yacht tenders. It's economical—runs 2½ hours on a gallon of fuel. It's the talk of all outdoor America and you should know *all* of its many features. Write for catalog.

OUTBOARD MOTORS CORPORATION
Ole Evinrude, *President*
5572-27th St. Milwaukee, Wis.

FOLD-LIGHT

taut, and measure the length along the ridgepole. Then measure the width, the height of the wall from sod cloth to eaves, the total height of the tent from the middle of the front to the top of the ridgepole, and finally the distance from the ridge to the juncture of the roof and wall.

Obtain eleven floor beams or joists 10 ft. 8 in. in length, if the tent proves to be 10 ft. wide as in the example illustrated; two sills 12 ft. long, and two porch sills 8 ft. long. Also cut the four corner posts of the tent, each 8 ft. 4 in. long, these points being higher than the wall of the tent to permit the use of baseboards and increase the headroom in the tent. The porch posts should be 9 ft. 4 in. long, and the door jambs 7 ft. 8 in. long. Square-headed bolts from ⅛ to ⅜ in. in diameter are amply strong; three sizes are needed—8, 6, and 4 in.

Lay the pair of porch posts upon one of the joists, 4 in. in from the ends of the joist and 2 ft. 4 in. from the base of the posts to the top of the joist. Clamp each joint with an iron or wooden clamp, bore and bolt the parts together loosely, square them accurately, and tighten the bolts.

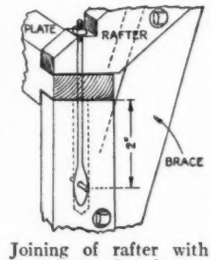
The two main H-frames for the tent are made in the same way except that the joists are placed 2 ft. 8 in. from the base of the posts to the top of the joist, since the floor of the tent is 4 in. higher than the floor of the porch. You are now ready to stand up the H-frames and clamp and bolt the sills in place. This skeleton frame is placed where you desire the tent to stand and is trued, leveled, and braced. Perpendicular bracing and additional joists may be added as needed.

The three A-frames for the roof are all alike, except that the rafters on the front of the porch are longer to provide support for the fly.

If you nail dressed 1 by 11¾ in. (or narrower) by 12 ft. boards in place on the tent frame to serve as flooring, you will have a convenient place on which to lay out and assemble the A-frames.

Where the rafters join the plate rails at the corners of the tent, holes are bored perpendicularly through both rafters and plate into the corner posts, as shown in the detail below. Into each of these holes is driven a bolt, the head of which has been heated, flattened, and drilled as illustrated. Through a small hole running at right angles to the bolt is driven a steel pin which, passing through the hole in the flattened end of the perpendicular bolt, anchors the bolt firmly so that the nut can be screwed down upon the rafter.

When the A-frames are in place, the ridge of the tent is set up and bolted to the cross braces at the top of the A's. The fly ridgepole and rails follow, fly angles being assembled and bolted in place experimentally before spreading the tent. Bolt holes for these are placed in the tent sides. These holes should be coated with a waterproof cement to prevent the canvas from raveling.



Joining of rafter with the plate rail and post.

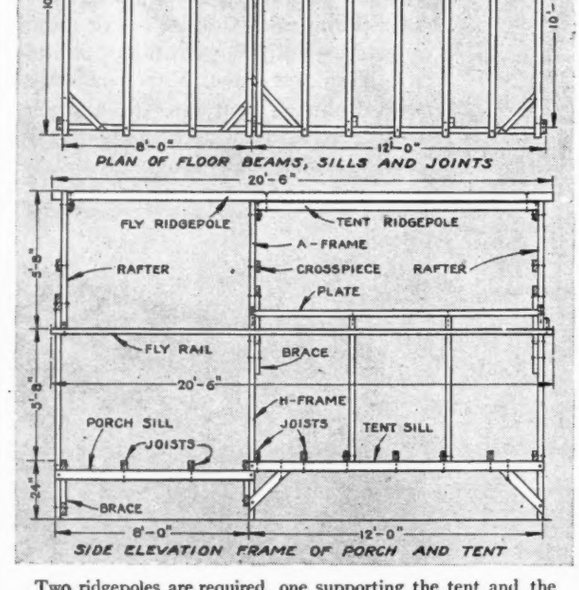
All holes should be bored carefully at right angles to the face of the frames to be joined for a snug but not a driving fit, for if the bolts fit too tightly it will be difficult to remove them.

The tent can be made mosquito-proof by putting metal insect screening over the porch frame and making bobbinet or mosquito netting tent flaps, the lower corners of which should be weighted to make them fall in place. A regular screen door should be hung, on the porch end, with a spring to shut it.

Cooking may be done on the porch with a portable stove, or another porch may be added at the rear for this (such a construction is shown in the illustration at the top of page 102). If this is done, the front porch can be used as a sitting and dining room.

For convenience in reassembly, it is well to letter and number the pieces of the frame, but it will be found unnecessary to knock down the A-frames in most cases. If the diagonal braces are removed and the bolts loosened, the H-frames can be folded within small compass.

Bolts and nuts should be well greased and stowed in a strong canvas bag, which may be securely tied to some member of the framework and stored away.



Two ridgepoles are required, one supporting the tent and the other for the fly. Another porch can be added on the other end.

HOME WORKSHOP CHEMISTRY

TINTING wools and silks by a new "dyeless" process developed recently in France opens a new field for the experimental activities of the amateur chemist. Simple inorganic chemicals, readily obtainable at any supply house, are the only materials required.

The chemistry of the process differs radically from the customary dyeing results obtained through the use of aniline dyes or by the precipitation of an insoluble colored pigment, such as khaki, Prussian blue, chrome yellow, or green in the fiber of the fabric by successive chemical baths.

In the new process a single chemical bath is used, and it reacts directly with the organic materials contained in the fibers of the fabric. The result is that the bath, which may be colorless, actually produces a beautiful colored compound in the fiber. The colors produced are remarkably "fast" in natural and artificial light. This treatment does not affect the durability or flexible qualities of the cloth, and it does effectively kill moth larvae in woolen fabrics.

The coloring bath itself is an acidified solution of a metal salt, to which a small amount of sodium nitrite (not nitrate) has been added. A wide range of colors is possible by the use of salts of different metals used either separately or in combination with each other, thus giving a wide and interesting field for experiment. Additional tints are obtained by the addition of 1½ parts in 1,000 of resorcin, pyrocatechin, or salicylic acid.

A representative coloring bath of the simplest type is composed of 1,000 grams of distilled water, 3 grams of iron sulphate crystals, 1½ grams of oxalic acid, 1½ grams of sulphuric acid, and 2½ grams of sodium nitrate.

OLIVE-GREEN tints are obtained by the use of iron salts, the color being strengthened by the addition of resorcin. Grayish-chestnut tones are produced with salts of cobalt, which change to a brown when copper is added.

Orange is obtained with cobalt salts and resorcin, becoming pink with the addition of nickel salts. Yellow tones are accentuated by tin salts and pyrocatechin, and weakened by salts of aluminum and zinc.

The "dyeing," if it may be called that, requires about an hour when the solution is kept between 170° and the boiling point. It may be done at room temperature, but the material must be immersed for a much longer period.

Only fabrics of animal origin, such as wool, natural silk, and fur are successfully tinted as outlined, since they alone contain the natural chemicals required to form the color (an organo-metallic complex). However, by a preliminary treatment of phenol or tanin, which is fixed with tartar emetic, such vegetable fabrics as cotton, linen, and artificial silks may be colored by this process.—A. P. A.

PHIL NEBEL
Band Master

17 Year Old Boy heads Own Harmonica Band

"A fellow who can't play the harmonica doesn't know the fun he's missing," writes Phil. "I started to play when I was 8 years old with a Hohner Harmonica. The Hohner is the easiest instrument to learn to play and the best, because you can play anything on it.

"I play over the radio very often, and I started a live-wire harmonica band and you ought to hear us play. We sure make real music . . . sounds like a big orchestra. It's great fun to play at entertainments and everybody who hears us say we sound like real professionals. Every fellow who wants to be popular ought to play a harmonica and join a harmonica band."

Phil Nebel

A QUALITY INSTRUMENT

Hohner Harmonicas are the choice of professionals everywhere. Musicians recognize them as "the world's best"; real musical instruments true in tone, accurate in pitch, perfect in workmanship. While Hohner Harmonicas are slightly higher in price than inferior instruments, you always have the satisfaction of knowing you own the best—one that enables you to play anything from jazz to opera. Don't be a "wall flower." Learn to play a Hohner. Fill out coupon now and mail it AT ONCE.

"Now, Fellows, all together!"

Phil raised his arms, and his harmonica band broke into the wonderful haunting strains of the "Gypsy Love Song." His audience sat spellbound and as the last note died away, wild applause shook the auditorium. For an hour Phil led his band in a programme that ranged from simple melodies to the latest popular airs. And as he finished, the crowd closed around him with congratulations and praise.

Whether he plays with his band or alone, Phil is always "the whole show." At parties, in camp and at school, he is easily the most popular boy in the crowd.

Wouldn't you like to have people wonder at your skill and all the boys and girls admire and envy you? Wouldn't it give you a thrill to be the leader of your own harmonica band? Then, here's your opportunity—your chance to learn to play the harmonica without its costing you a red cent.

FREE INSTRUCTION BOOK

To play the harmonica is far easier than you think. You don't have to have a special talent—millions of boys and girls no smarter than you are good players, and you can be, too. The Free Illustrated Instruction Book makes learning a game. You just look at the picture, read the directions and then play. Why, you can begin to play real music the day you get the book—even if you can't read a note right now—that's how easy it all is. So send the coupon today—sure!

Bill Latham says, "I never played a harmonica in my life but after I got the Instruction Book in the morning mail I learned to play almost by night."

If you want to start a harmonica band, ask your teacher or scout master to send for special information which will enable them to help you.

You can get Hohner Harmonicas everywhere; in many different styles—at all prices.

FREE *Illustrated Harmonica Instruction Book*

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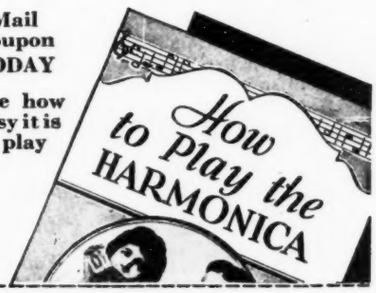
See how easy it is to play



HOHNER

Hohner "MARINE BAND" the ideal instrument for the beginner, embodying almost two octaves in the diatonic scale. . . . . Price 60c

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Dept. 19-G, New York

Please send me at once FREE Illustrated Instruction Book which tells me how to play the harmonica.

Name_____

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He uses

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When the top leaks or cracks, when joints loosen, when door bumpers are worn, and for repairing dents in body and fenders, the best auto repair shops use Plastic Wood. It handles like putty and hardens into wood, and sticks fast to wood, metal, or other material—but scrape away all paint or dirt before applying. It can be sanded to a hair edge, and takes paint, varnish or lacquer perfectly. Any automobile owner can use it for many jobs on his own car, as well as for repairs usual home.

PLASTIC WOOD
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In addition to the natural wood color in which Plastic Wood is regularly supplied, many dealers carry it in mahogany, oak, walnut and other wood colors in handy tubes.

Industrial users can obtain Plastic Wood in any colors desired. Further information and bulk prices will gladly be furnished on request to the factory.

Plastic Wood Solvent

To soften Plastic Wood, to clean it from the hands or tools, and to prevent it from hardening from too frequent opening of the can, use Plastic Wood Solvent. In 25 and 50 cent cans.

Handles like Putty

Hardens into Wood

Tube 25 cts.— ¼ lb. can 35 cts.— 1 lb. can $1.00

At Hardware and Paint Stores

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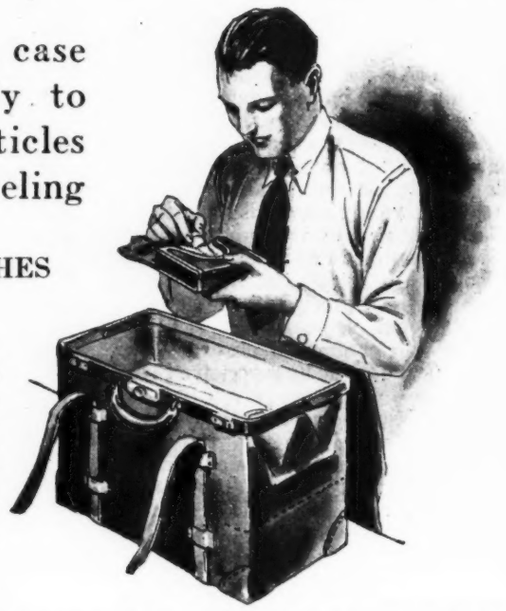
ADDISON-LESLIE COMPANY

329 Bolivar St., Canton, Mass.

Leather Craft Simplified

Steps in making a case designed especially to fit those toilet articles you use when traveling

By F. CLARKE HUGHES



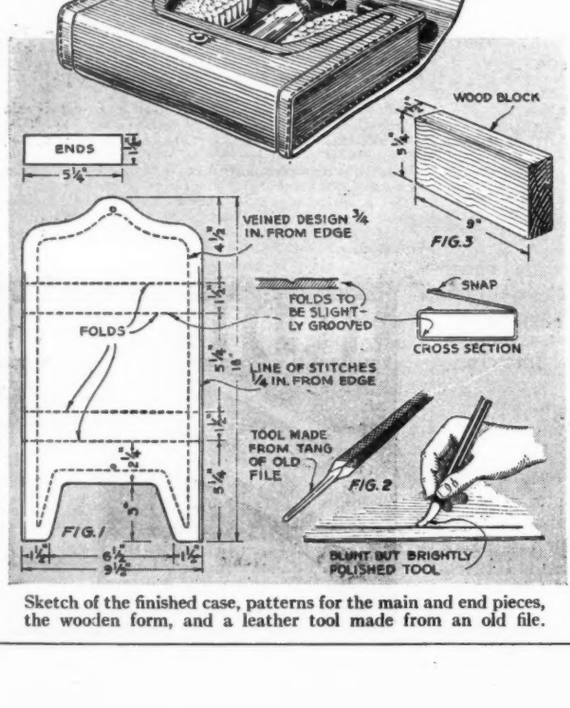
In this small case can be carried all of a man's toilet articles, except the razor, which generally has its own fitted case.

HANDMADE of sole leather, the traveler's case illustrated is neat in appearance, convenient, and practically indestructible. Bought at a retail shop, it would cost $5 or more; but if made according to the accompanying directions the outlay need not be more than $1 at the most.

The case differs in design from the boxlike one described in a previous article (P.S.M., June '30, p. 115). It is made to accommodate two brushes, a comb, a box of powder, a nail file, a toothbrush, and a tube each of tooth paste and shaving cream, but the dimensions can be increased, if desired, so that it will hold additional toilet articles.

It is suggested that the reader first lay out the articles he wishes to place in the case so that he can estimate closely what size will be needed; and by using the accompanying design as a guide, he may then construct a cardboard model, fastening it together with a little glue at the corners. In this way the size may be tested and altered if necessary.

After a satisfactory model has been made, the material should be estimated and one piece of leather purchased large enough to make the sides of the case. This stock, which may be obtained from a neighborhood shoemaker, should be a good grade of sole leather about ⅛ in. thick. The thickness should be reasonably uniform throughout, and the face should be of an even color with no splotches or markings. In addition to this piece, there should be two small pieces for the case ends.



Sketch of the finished case, patterns for the main and end pieces, the wooden form, and a leather tool made from an old file.

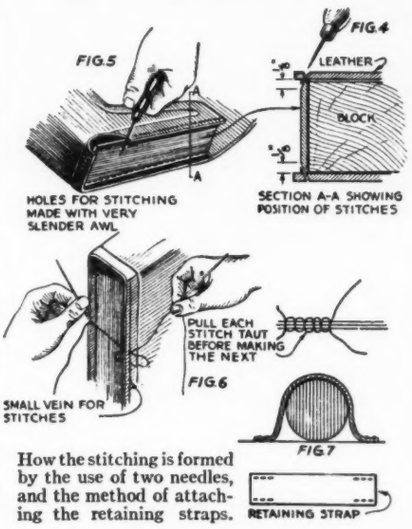
The lines should be laid out on the rough side or back of the leather and cut with a sharp knife so that they will be smooth and even. All lines that are to be folded should be slightly grooved or veined so that they will fold more evenly. These grooves may be cut with the point of a sharp knife.

When the case is cut out and ready to be sewed, the surface design may be laid out on the face. In Fig. 1 the veined design, which is shown as a dotted line, is placed about ¾ in. from the edge. Before tooling this vein, the leather should be moistened and the lines drawn on the surface with a hard, blunt pencil. Trace over the lines with the lead pencil several times to deepen them; then use a regular leather tool, an awl, or a homemade tool as shown

in Fig. 2 for finishing the tooling process. When the leather is dry, these lines will be permanent.

A wooden block should be made exactly the size of the inside of the case, as illustrated in Fig. 3. Bind the leather loosely around this block with heavy twine. Moistening the leather will make it more pliable and easier to shape.

The sewing should be done with strong linen or silk thread. Use a length with a large needle on each end as shown in Fig. 6. If desired, shoemaker's bristles may be used instead of the needles. Make holes for the stitches as needed with a slender awl (see Figs. 4 and 5); these should be from 1/16 to 1/8 in. apart and far



How the stitching is formed by the use of two needles, and the method of attaching the retaining straps.

enough from the edge of the leather to allow each stitch to go down into the end piece as shown in Fig. 4.

It is suggested that the reader carefully examine some good examples of sewing such as is found on heavy luggage.

In Fig. 6 the method of sewing is shown —how the needles enter the holes from both sides in order to give a continuous line of stitching. A very narrow vein made with a small awl will keep the stitches even.

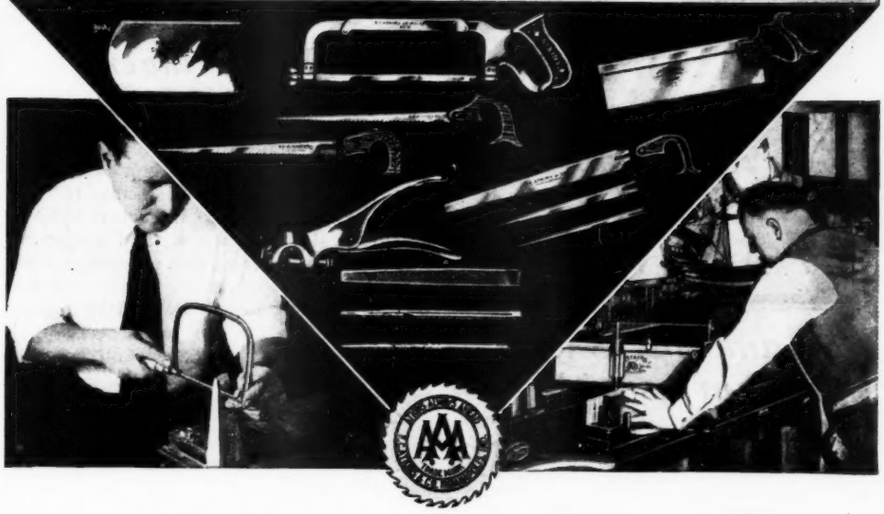
After the sewing is finished, the block may be removed and the retaining straps for the accessories sewed into place with stitching as shown in Fig. 7.

A snap fastener completes the case unless it is desired to line the inside with thin leather, such as kid or calf, or with silk, although lining the case is by no means essential.

SETTING A HARD SAW

EVERY carpenter knows how difficult it is to set a hard saw without breaking several teeth. In my experience of nearly sixty years as a carpenter, I have found the following to be a safe and effective method: Place the saw in a saw clamp or vise, keeping it up about 2 in. above the jaw. Set an old saw file between the teeth of the saw and give it a gentle but firm twist in the direction of the setting. Then skip one tooth, placing the file in every other space between teeth, since two teeth are set at the same time, one each way.—J. S.

ATKINS SILVER STEEL SAWS



Small Saws for Fine, Fast Cutting in Your Home Shop

NO wonder so many home craftsmen turn to ATKINS Small Saws when they have fine cutting to do. For these are the saws the finest artisans use the world over.

But you don't have to be an expert to do good work with ATKINS Saws. It's surprising what clean, accurate cuts even an amateur can make with these fine saws. The secret is in "Silver Steel," the world-famous saw steel used only by ATKINS.

It makes your saw take a keener edge, cut faster and easier, stay sharp longer, and outlast two or three ordinary saws. Many other exclusive features of ATKINS Saws help save you time, energy and money.

Here are a few favorite ATKINS Small Saws for home shops:

No. 1 Mitre Saw: Ideal for mitre box. Heavy back holds blade rigid; fine teeth cut quickly, smoothly. Silver steel blades, 18 to 32 inches long.

No. 2 Back Saw: Cuts mitres, grooves mortises, tenons, etc. Extra stiff back makes blade run true. Silver Steel. 8 to 18-inch lengths.

No. 10 Hack Saw: Frame is adjustable for 8 to 12-inch blades. "Pistol Grip" handle. Choice of ATKINS Non-Breakable Blades or new Silver Steel Blue-End Blades which cut *any* metal TWICE as fast and last SIX times as long as alloy steel blades.

No. 6 Keyhole Saw: Silver Steel blade is tough and sharp—hard to break, easy to cut with. 10 and 12-inch lengths.

No. 2 Compass Saw: Silver Steel; cuts speedily, stands hard use. 10 to 16-inch lengths. No. 11 Compass Saw has blade adjustable to cut at various angles.

Atkins Silver Steel Hand Saws

Atkins Silver Steel Dado Heads

No. 50 Coping Saw: Silver Steel blade cuts at any angle. Strong, nickeled frame; hardwood handle. A high-grade saw for extra fine work.

No. 3 Nest of Saws: Three saws for one adjustable handle. Keyhole, Compass and Nail-Cutting Saw. Needed in every kit.

No. 395 Saw Set: Makes it easy to give perfect set to all saws with from 4 to 16 teeth to inch.

Files of Silver Steel, in every size and style, for faster sharpening, filing and finishing.

No. "O" Scraper Blades: Silver Steel makes sharper-cutting, longer-lasting blades to scrape floors, finish surfaces, remove paint, etc. All sizes.

Dozens of other ATKINS Silver Steel Saws—"A Perfect Saw for Every Purpose." See them at your Hardware Store. Write us for the four FREE booklets on saws for the home shop. Just send coupon below.

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Please send me the four Home Workshop Booklets on Saws, FREE.

Name.....

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My dealer is.....

Get these 4 Saw Books FREE

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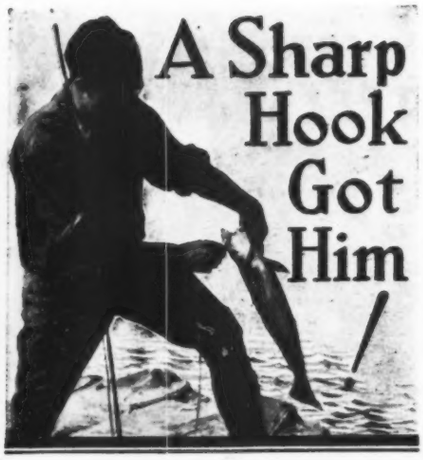


A Sharp Hook Got Him

—and this is what Sharpened it

Carborundum

REG. U. S. PAT. OFF.

BRAND

HOOK STONE

KEEP all your hooks sharp with this stone—touch them up before and every once in a while during your fishing trip.
Specially designed to sharpen hooks and gaffs. Produces a needle-like point in a twinkling, even on dull blunted hooks. Ask for Carborundum Brand Hook Stone No. 44. Price, 50c.

Sportsmen's Oblong Combination Stone

The stone for every sportsman's outfit. Coarse grit one side for very dull knives, fine grit other side for keen, smooth edge. In neat leather case. Ask for No. 114, 4 x 1½ inches. Price, $1.25.

Sportsmen's Round Combination Stone

Puts keen edge on axes, hatchets, sheath or clasp knives. Ask for No. 113, 3-inch diameter, in leather case. Price, $1.50.

From your Dealer or Direct

The CARBORUNDUM Company
Niagara Falls, N. Y.
Canadian Carborundum Co., Ltd.
Niagara Falls, Ont.

(Carborundum is the Registered Trade Mark of The Carborundum Company for its products)

Four Ideas for Outdoor Men

A Gun Cabinet Design—Marking Buoys—Fish Stringers and Fishhook Extractors

EASILY made in the workshop of the home mechanic, this gun cabinet is a boon to the sportsman. It stands 5 ft. 10 in. high over all. The upper section is 10 by 14½ in. by 4 ft. inside, and accommodate four guns and several fishing rods. These stand upright in a rack fastened to the back, which is covered with green billiard cloth. The lower section is slightly wider and deeper and contains one large drawer, which serves as a handy catch-all for kodak, shotgun shells, and miscellaneous equipment, and six small drawers for ammunition, cleaning kits, fly book, reels, and the like.

Ample storage room is provided for accessories.

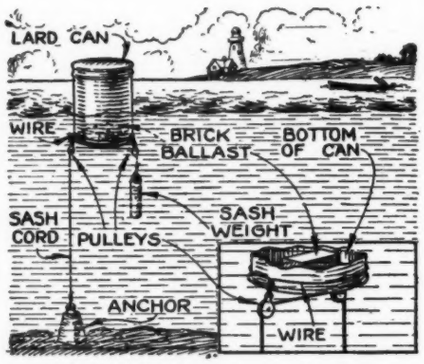
The top of the base section is of ⅜-in. plywood, with a molding mitered around its edge so that the upper section can be set snugly in place on the lower without any fastening. This two-part construction makes the cabinet easier to move, yet the joint is well hidden by the molding around the edge.

The drawer fronts and the door and panel stiles (upright members) are of 1-in. oak, the panels of ⅜-in. oak veneer. The legs were sawed and carved from oak blocks 1¾ by 2½ by 5 in. The two front legs project at an angle of 45° from the sides and the front, but the back legs stand out at right angles to the sides.

A frame made of 2-in. oak molding serves as a finish for the top; and into rabbets in its upper edge a sheet of oak veneer is set flush, making the construction dust proof. The backs of both the upper and lower sections are of plywood like the panels, and are set in rabbets planed on the inside rear edges of the side frames.—C. M. KREIDER.

MARKING buoys that will remain anchored and yet rise and fall with the tide can be made from large tin lard cans as illustrated below.

Thread two galvanized iron pulleys on a piece of ⅛-in. iron or copper wire. Pass the wire snugly about the end of the can opposite the cover and twist the ends together. Slip the pulleys along the wire until they are centered on opposite sides of the can and, passing a tenpenny nail through above the sheave, twist alternately until the wire is so tight around the can that it cannot slip. A little solder at various points will help to hold the wire securely.



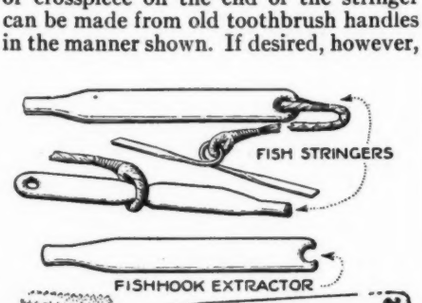
As it rises and falls with the tide the buoy forms a conspicuous marker for boat racing.

A well-paraffined 3/16-in. sash cord is rove through the pulleys, one end is fastened to the anchor, and the other end is tied to a sash weight. The sash weight holds the buoy directly over the anchor and pays out and shortens the line automatically to suit the tide or waves

Ballast may be placed in the can to hold it in a vertical position. A brick fastened in place with hot tar or asphalt is suitable for this purpose.—J. V. H.

FISH stringers and fishhook extractors whittled from old toothbrushes make inexpensive additions to the fishing tackle box.

Both the threading needle and the stop or crosspiece on the end of the stringer can be made from old toothbrush handles in the manner shown. If desired, however, the crosspiece can be formed by bending heavy wire to shape and flattening the ends to stiffen them.



The discarded toothbrush handles can be easily whittled to shape with a sharp pocketknife.

Removing hooks from fish after they have been caught becomes a simple matter when an extractor made from an old toothbrush is used. The notch is obtained by cutting through the eye at the end of the handle as suggested in the illustration.—C. ANTHONY VAN KAMMEN.

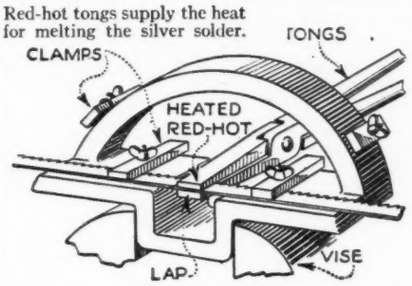
This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Repairing a Broken Band Saw Blade

BAND saw blades that have broken can be quickly and effectively sweated together if the proper procedure is followed. The method to be described has been used by the writer for many years, and he has yet to fail in obtaining a strong joint.

The broken ends of the blade are first cut off square with a chisel in such a way that the teeth match up, and each end is carefully beveled with a small file. The ends are then placed in a jig having some means of holding the loose ends rigid and in a straight line. A suitable jig for this purpose is shown in the accompanying illustration. This type is convenient because it not only supplies a suitable

Red-hot tongs supply the heat for melting the silver solder.



clamp for this part of the work but an additional one for the filing and finishing necessary after the joint has been soldered.

Coat the ends of the lap with borax or other soldering flux and place a piece of silver solder over the lap. As in all soldering operations, take great care that both the joint and the solder are clean.

Select tongs that will fit over the joint tightly and cover it completely, and heat them in a clean fire to almost a white heat. Grasp the solder-covered lap with the tongs and grip the joint tightly until the blade around the lap has turned red and the solder has flowed over the joint. Carefully release the pressure, replace the hot tongs with a cold pair, and hold until the blade becomes cold. This change from the hot to the cold tongs should be done quickly and without placing any undue tension or twist on the blade.

The blade then may be changed to the semicircular upper portion of the jig, which serves to hold it for filing, and any unevenness at the joint is removed. Before doing this, however, the temper of the jointed portion should be drawn to a purple.

This method also can be applied to the jointing of broken steel tapes if two lap joints and an extra piece of metal are used in order to keep the tape the correct length. Tin from a tobacco can may be used for the additional piece of stock at the joint.—W. S. GALLMAN.

THE more absorbent woods require a priming paint coat that is rich in linseed oil, with a small amount of turpentine added. The less absorbent woods need less oil but more turpentine to help the oil penetrate into the wood.

$1295 buys a CHRIS-CRAFT

NO longer is the possession of a fast, luxurious motorboat the special privilege of the wealthy. Chris-Craft now offers a 17-foot, 25-mile-an-hour runabout at $1295, by far the lowest price at which a Chris-Craft ever sold. A deferred payment plan makes it possible for the man of average means to own the world's finest small motorboat. ' ' ' Here is the ideal fast, seaworthy motorboat for the inland lakes and rivers. It gets about in a surprisingly small, shallow body of water, yet it has all the safety of the larger Chris-Craft in the open waters—the same dependability, luxury and style. Read about its special features. Get our new descriptive catalog. Order early and enjoy a full season of delightful motoring on the water. Chris-Craft merchants will demonstrate for you and let you drive a Chris-Craft.

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World's Largest Builders of Mahogany Motor Boats

Features of the 17-foot Runabout

25 miles per hour · Length 17 feet · Beam 5' 7" · Freeboard, forward 24" · Freeboard, aft 18" · Draught 16½" · Double planked bottom · Positive steering control (shaft connection—no cables) · Smith Automatic bailer · Full ventilating automobile type windshield · Screw fastened throughout · Salt water equipment · Lifting ring fore and aft · Tachometer, oil pressure gauge, ammeter · Fire extinguisher, Kapoc cushions, and all accessories leaves nothing to buy.

25 Models: Runabouts—Sedans — Commuters — Cruisers—Yachts—17 to 48 feet—$1295 to $35,000

FORMS TO CAST LEAD SOLDIERS, INDIANS, TRAPPERS, Hunters, Wild and Farm Animals. 222 Wonderful "True to Life" models. Easy and inexpensive to make. I furnish all necessary material. Send 5c Stamp for Illustrated Catalogue.
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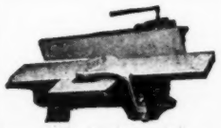
Rider Agents Wanted Select from 44 Styles, colors and sizes of Mead Bicycles. Ride and exhibit sample RANGER and make money.
Factory to Riders We ship on approval for 30 Days' Free Trial, direct from FACTORY. Get our marvelous offers. Easy Payments. $5 down.
Tires lamps, horns, wheels, parts, equipment, and repairs at half usual price. Established 36 years.
Mead CYCLE COMPANY DEPT. R-250 CHICAGO Write us today for free catalog

Marvelous How Easily and Quickly You Make Things



Four-inch Jointer 20-inch tables. Fence tilts both ways..... $25

Enjoy the thrill of building. *Make spare time useful and profitable.* Have a *real* shop. Sturdy, strong, speedy BOICE-CRANE bench machines are what you need. *Low as $10. starts you.* Send for FREE 80-page catalog. Complete descriptions of Circular Saws, Band Saws, Lathes, Jointers and Jig Saw. Also big FREE book "How to Make Screens." Get our interesting literature, low prices and liberal terms.

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Universal Handisaw
Big, Powerful
$30 Ⓢ

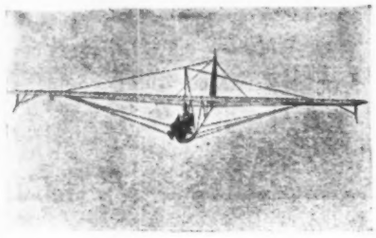
Saws, rips, dadoes, mitres, sands, bores mortises, etc. Wonderful value.

Buy Now Pay Later

LEARN TO FLY IN A WACO GLIDER

• • •

It's a fascinating sport and an easy way to get flight training at small expense



The WACO glider is built to WACO standards and has many superior design features. It will take-off and land at 20 m.p.h. and has a gliding angle of 15 to 1. It is priced at $385 complete, boxed for shipment, f.o.b. Troy, Ohio . . . or $295 partially assembled, ready for wing covering and doping.

ARE YOU one of those who now believe that flying is not such a superhuman accomplishment after all? . . . and would you like to prove it?

One of these primary training gliders by WACO is your opportunity. You can easily and quickly get the feel of the controls and the thrill of flight, and have a tremendous lot of fun in doing it.

The price of the WACO glider complete, ready for rigging, is only $385 . . . less than the average fee for primary flying instruction. A few of you can get together if you wish, form a Glider Club, share the price of the Glider . . . and the fun is on.

A Glider Built by WACO

The WACO glider is such a craft as you would expect of WACO. The fuselage is welded of aircraft steel tubing. It can't splinter. It is braced to withstand the most abusive handling. The wings are constructed of best aircraft stock, according to best aircraft practice. Wing skids with rubber shock cord protect the wing tips from damage and support the wings when the glider is at rest. The positive, fool-proof towing hook is of novel design. In every detail the WACO glider reflects the practical experience of WACO designers.

Send for Full Details

Send for descriptive folder just off the press. It will tell, too, about forming a Glider Club. Send for your copy of WACO folder GS . . . today.

THE WACO AIRCRAFT COMPANY, TROY, OHIO

WACO AIRPLANES

"ASK ANY PILOT"

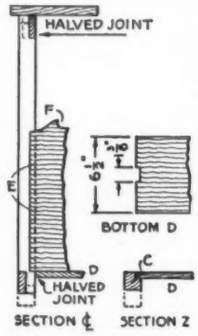
You Can Slide Big Magazines from This Rack

By David Webster

IT MAY require a second glance at this table to appreciate the genuine convenience of the large magazine rack, which unlike most racks is open at the ends.

Mahogany—or red gum, which may be stained mahogany—is an appropriate wood to use unless the piece is to be lacquered, in which case whitewood or pine is suitable.

Get out the top; the legs, which are 1⅜ by 1⅜ by 24 in.; the top crosspiece or transom *A;* and the feet *B*. Make halved joints as shown in the sectional views on the following page, and work *A* and *B* to the desired form. A pattern for each design may be made by laying out 2-in. squares on pasteboard, by drawing the curves in their correct relation to them, and by cutting to the lines. The halved joints may be fastened with glue and nails or screws.

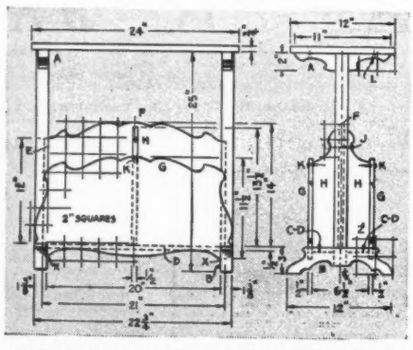


Details of halved joints and bottom.

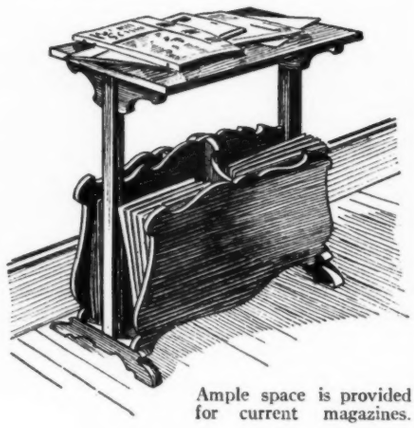
Cut the rabbet *C* in the feet to receive the bottom *D*, the rabbet being 6½ in. long. Make the bottom ½ by 6½ by 21 in. and cut a ½ by 1⅜ in. notch in the center at each end of the bottom to allow it to fit over the 1⅜-in. leg. Mortise the groove *E* in the leg, beginning 2 in. from the bottom; it should be ½ by ½ by 12 in. to receive the end of the center partition *F*, which is ½ by 14 by 21 in. This partition, which should be shaped by transferring squares and curves, is fitted into groove *E*. Finish the edges carefully.

Smooth, sandpaper, and assemble legs, transom, feet, bottom, and center partition, using glue sparingly and driving 1½-in. No. 16 brads where necessary.

Two fronts *G*, ½ by 11½ by 22¾ in., should be shaped and finished so that their bottom edges will fit against the feet as at *X*. Two partitions *H*, ½ by 3 by 13½ in., should be made and the curved edges finished. These and the fronts now may be smoothed, sandpapered, and fastened in place. A 2-in. No. 8 roundhead screw as at *J*, which will pass through *H* and *F* and into *H* on the other side, will hold *H* in place. Besides driving brads through the fronts into *H* and into the bottom *D*, drive a screw as at *K* to make the top edges of the fronts *G* firm enough to resist hard usage.



Halved joints held with glue and nails or screws are used in the arm, leg, and foot assembly.

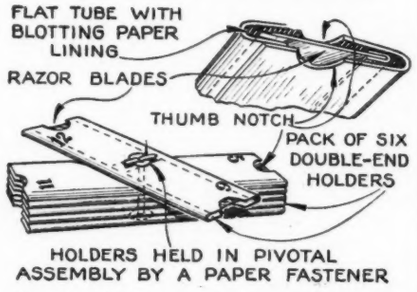


Ample space is provided for current magazines.

Smooth and sandpaper the top and fasten it in place with screws as at *L*.

If the table is to be finished in the natural color or stained, a simple method is to give it three or more rather thin coats of light orange shellac. Rub each with No. 4/0 sandpaper and spread a coat of wax on the last. Polish with a soft, lintless cloth.

BLOTTING PAPER HOLDER DRIES RAZOR BLADES


FLAT TUBE WITH BLOTTING PAPER LINING
RAZOR BLADES
THUMB NOTCH
PACK OF SIX DOUBLE-END HOLDERS
HOLDERS HELD IN PIVOTAL ASSEMBLY BY A PAPER FASTENER

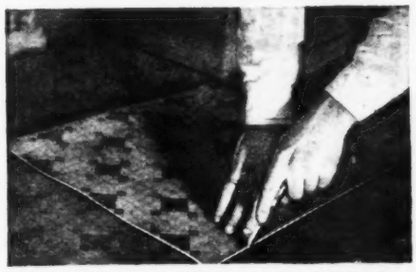
How the blotting paper tubes are folded and assembled so as to form twelve blade holders.

BY FOLDING 3¾ in. wide paper-covered blotting paper into flat tubes in the manner shown below, it is possible to provide yourself with a safety razor blade holder that will keep your blades free from rust. The tubes should be made about 1 in. wide.

Each tube serves to hold two blades, so that when the six tubes are fastened together in the center with a paper fastener there is room for twelve blades. The holders can be numbered for convenience.—GEORGE T. ROBINSON.

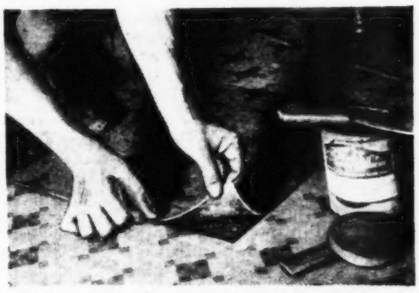
Repairing Linoleum So the Patches Do Not Show

By EVERETT EAMES



How the new piece is used as a guide for cutting out the old linoleum to be replaced.

FLOOR coverings of inlaid linoleum ordinarily would last a lifetime if the wear could be distributed uniformly over the whole surface. Thin places, indicated by the showing through of the burlap base, first appear in front of the sink, stove, and ironing board, or in other much used locations. Almost as unsightly are the cracked and curled-up edges so often seen, especially in door-

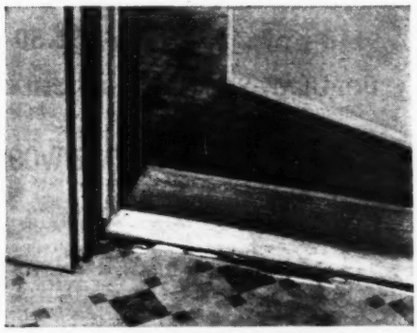


Waterproof linoleum cement is used to stick the linoleum patch neatly and securely in place.

ways, but these are due not to wear but to water, which seeps in around the edges when the floor is washed; and the damage is worse when so-called water-resisting cement rather than genuine waterproof cement has been used.

The appearance of worn spots does not necessitate complete replacement, as most of the ordinary stock patterns of linoleum can be easily matched.

To restore a damaged section, carefully cut out a rectangular piece large enough to



Curled-up and cracked edges like this are caused by the water used in washing the floor.

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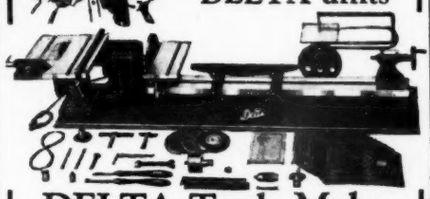

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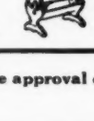

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overlap the worn place at least 6 in. on all sides. Lay this piece so that it accurately matches the pattern at the place to be repaired, and with firm, even strokes of a sharp knife cut through the old linoleum. Peel off the worn piece and scrape off all loose remains of the old cement. In removing the piece, try not to tear or damage the felt lining paper underneath the linoleum, provided there is any. Incidentally, new linoleum always should be laid on a base of linoleum felt or builders' felt.

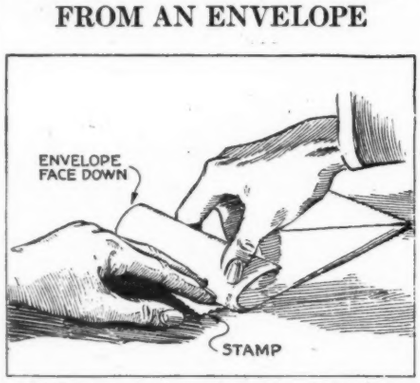
Nailing down a strip of zinc or brass to protect the exposed edge of a patch in a doorway.

Cover the open place with waterproof linoleum cement, using a steel scraper or trowel to spread the cement as evenly as possible. Quickly set in the new piece and press it firmly in place. Wipe off any excess cement with a cloth wet with alcohol. Use shoemakers' brass brads to tack down any places along the edge which have a tendency to pull away from the floor. Cover the patch with bricks or other weights and allow the cement to harden overnight.

As the new linoleum is slightly thicker than the old, sandpaper the edges if they stick up too noticeably; that is, more than 1/32 in.

If repairs are to be made in a doorway, a new strip at least 6 in. wide should be used in order to allow the old linoleum to be cut back well beyond the water-damaged part. Protect the new linoleum with a strip of brass or zinc edging, which can be obtained wherever linoleum is sold and in hardware stores.

HOW TO REMOVE STAMPS FROM AN ENVELOPE



Hold the stamp down flat and pull the envelope from it. The stamp will not be torn.

WHEN you have to remove a stamp from an envelope, try the stamp collector's trick of tearing the envelope from the stamp as shown above. The same method can be used to remove any piece of paper that is fastened to another with paste.—WORTH STEWART.

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30x3½	2.25	1.00	29x4.50	2.40	1.15
31x4	2.95	1.15	30x4.50	2.45	1.20
32x4	2.95	1.15	30x4.95	2.90	1.35
33x4	2.95	1.15	28x5.25	2.95	1.35
34x4	3.50	1.15	29x5.25	2.95	1.35
32x4½	3.20	1.45	31x5.25	3.10	1.35
33x4½	3.20	1.45	30x5.77	3.20	1.40
34x4½	3.45	1.45	32x6.00	3.20	1.40
30x5	3.60	1.75	33x6.00	3.20	1.45
33x5	3.60	1.76	32x6.20	3.50	1.65
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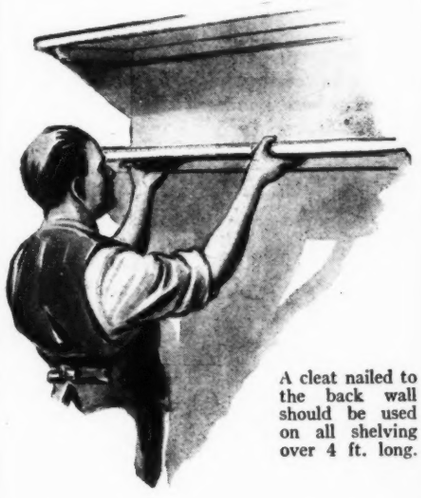
A definite program for getting ahead financially will be found on page four of this issue.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

THE SHIPSHAPE HOME

Hints on Building Shelving and Bookcases

OF ALL the carpentry jobs the handy man is called upon to undertake, the most common is the construction of shelving. Many of the principal types will be described in this article and the one to follow in the August issue.



A cleat nailed to the back wall should be used on all shelving over 4 ft. long.

How may stationary shelves be built between walls?

1. The logical way is to rest the shelves upon cleats nailed to the wall as in Fig. 1. A cleat ½ in. thick and 1½ inches wide with the front end cut under as at *A* or mitered as at *B* and set back from the edge of the shelf ½ in. or more will appear less amateurish than a heavier cleat. If the shelf is 4 ft. long or more, it should be supported in the middle by a cleat nailed to the back wall. Should the shelf be in a clothes closet, this back cleat may be about 3 in. wide so that it will support clothes hooks as at *C*.

2. In fastening cleats to a plastered wall with nails, endeavor to locate the studs (uprights) behind the plaster, because the nails should be driven in them; the laths alone do not supply sufficient strength. The studs are commonly placed 16 in. between centers. They may be found by tapping lightly along the wall with a hammer and noting the difference in sound, the firmer response to the blow being directly over a stud.

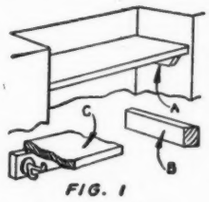
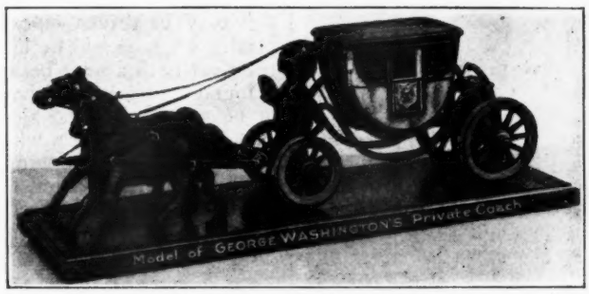


FIG. 1

Cleat ends should be undercut or mitered.

3. If the cleat is placed upon a plaster-



Size: 20" long; 6" wide; 8½" high.

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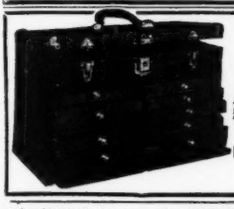

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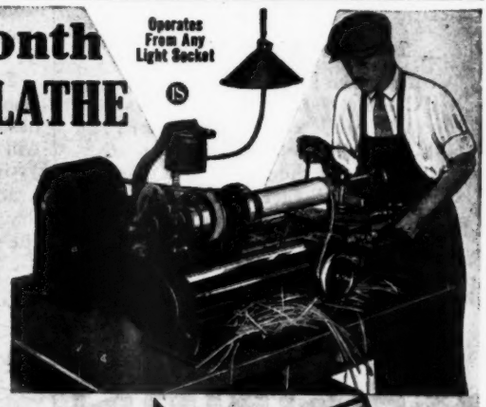

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15"x6'	1550 "	543	720
16"x8'	2035 "	638	817

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covered brick wall or a chimney, a trial nail may be driven repeatedly into the plaster where it will be later covered by the cleat until a joint between the bricks is found. A trial nail driven ½ in. above or below, or on either side of the point thus located, will show whether the point is over a level or a plumb joint of the brickwork. If the latter, the other joints usually will be found about 8½ in., 17 in., 25½ in., etc., in either direction. Level joints are about 2⅜ in. apart.

How should corner shelves be constructed?

1. They may be placed upon cleats fastened to the wall by the method just described. This construction is shown at *A*, Fig. 2. If the cleats do not bear over

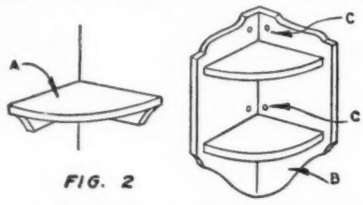

FIG. 2

Corner shelves can be built by either method, and a door or front frame added, if desired.

the stud, the front end of each should be fastened by screws driven into the laths.

2. The "whatnot" form of corner shelves may be made by nailing through the sides into the shelves as at *B*, Fig. 2, and fastening them in the back corner at *C*, where the screws can reach the corner studs.

In what ways may a shelf be fastened without end supports?

This form of shelf, which is the forerunner of the elaborate mantels of the present time, is one of the most common.

1. The primitive shelf was supported by pegs or iron rods driven into a log wall or masonry, as at *A*, Fig. 3, or by a wooden brace as at *B* until the more convenient iron bracket of *C* was adopted. The form of shelf at *D* is also common.

2. If placed upon masonry walls, the brackets may be fastened easily as described above for cleats. As trial nails will be likely to show, it is safer to drill ½-in. holes where the screws through the brackets are to be placed and to drive a dry hardwood plug in tightly to receive the screws.

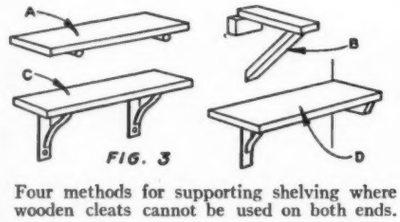

FIG. 3

Four methods for supporting shelving where wooden cleats cannot be used on both ends.

What are suitable dimensions for bookcases of the movable type?

Usually portable shelves are built to meet a definite need or to fit a certain place. In making a bookcase, for example the number and size of the books must be considered. The bottom shelf should be about 6 in. from the floor to allow sweeping under it easily. The clear space between the lower and the second shelves may be as much as 12 in., which will accommodate most large books. If the spaces are then reduced about 1 in. each until a minimum of 8 in. is reached, the case will hold the average assortment of books with little or no waste space.

What is the simplest way to assemble a bookcase?

With nails or screws as shown in Fig. 4 at *A* and *B*. This is a simple method of construction, but little can be said in its favor. The ends of the shelves should be cut square and all of the same length, for unless other bracing is used the thickness of the shelves and the holding power of the nails or screws driven into the end wood form the only elements of strength —not much to rely on.

Nailed or screwed shelves of trough form as in Fig. 4 at *C* may be made by this method with the assurance of sufficient strength for ordinary use. This is a good expediment to remember.

Shelves resting upon cleats as in Fig. 5 are an improvement upon nailed or screwed shelves. To a certain degree the cleats help to hold the case square if the shelves are well fastened both to the ends and the cleats, but such a case is likely to become wobbly after a while. This may be remedied by bracing, which will be discussed later, or by placing a trough shelf at the top.

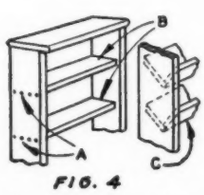

FIG. 4

Trough-shaped bookshelves make for solidity.

Is there a better method of supporting common square-cut shelves?

Yes. Shelves built as suggested in Fig. 6 and fastened with nails or screws.

1. Cut the shelves and ends to the exact form and dimensions, the top and bottom shelves being ½ in. narrower than the others to allow for the thickness of the ½ in. by about 6 in. backboards *A*, which will give ample stiffness to the case.

2. Beginning with the bottom shelf, fasten each shelf with nails or screws. Next, cut four battens *B*, say ¼ by 1 in. in cross section and as long as the desired distance between the shelves. These may be plain rectangular strips or they may be cut from some suitable flat molding. Fasten them to the end boards as shown, using glue and brads. They should be placed about ¼ in. from the front edge of the end pieces and flush with the back edge. Put the second shelf in place and continue in the same way.

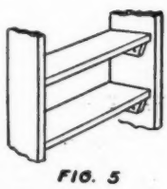

FIG. 5

Cleats add to the strength of the case.

3. Note that the ends of the case projecting above the top shelf give support to books. This variant may be applied to other methods of shelf construction.

4. It is always a good plan to make the back corner of the bottom of the end a little shorter than the front; this will

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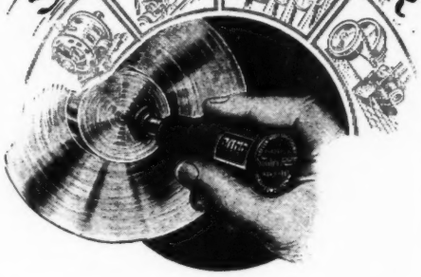

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allow the case to lean back a little, say ½ in. as at *C*, to eliminate any danger of tipping forward.

How are grooved shelves constructed?

Grooved-in or, to use the carpenter's term, dadoed shelves are amply supported by the end pieces, therefore this method of construction is the best for the purpose.

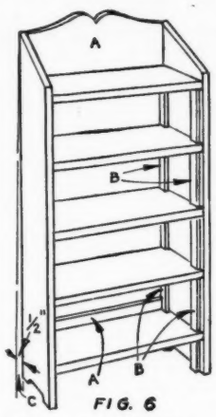

FIG. 6

Battens used between shelves as supports.

1. Cut the shelves and the ends to shape, making an allowance of ¼ in. on each end of each shelf as at *A*, Fig. 7. Mark the exact thickness of each shelf on the end pieces as at *B* with a sharp pointed knife, making a deep cut. With a scratch gage, make a line on each edge ¼ in. from the inside face to indicate the depth of the groove. Tack a straight strip of wood against the line on the outside of the groove as at *D*, and make a ¼ in. deep saw cut to the gage line *C*. Then change the guide to the other side of the groove and repeat the process. With a narrow chisel cut the wood between the saw cuts away to marks *C*.

2. Place the shelves together as at *E* to be sure they are of uniform length. If necessary, plane the ends while the boards are thus held together.

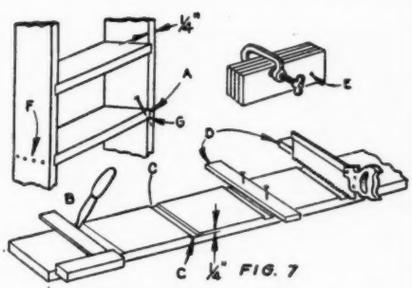

FIG. 7

Grooved-in or dadoed shelves, and how guide strips are used to aid in sawing the joints.

3. Assemble the case by driving nails or screws as at *F;* or while holding the ends in place by clamps, drive nails slantwise as at *G*, which is better craftsmanship although much harder to do.

4. The case may be braced by backboards as in Fig. 6, or with corner blocks as suggested in Fig. 8. A board 4 in. wide is sawed to make blocks as suggested at *A*, and the blocks are fastened under the top and bottom shelves with glue and 1½-in. No. 10 screws as at *B* in Fig. 8.—C. A. K.

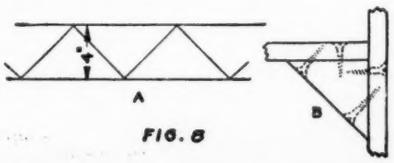

FIG. 8

Corner blocks held in place with screws may be substituted for the backboards shown in Fig. 6.

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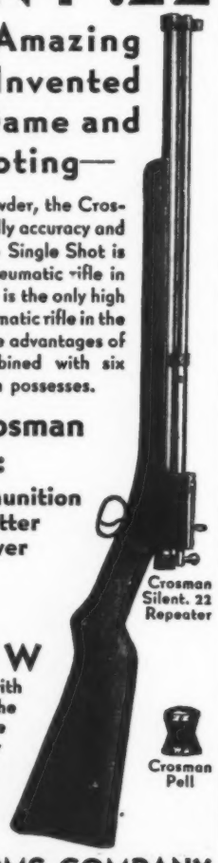

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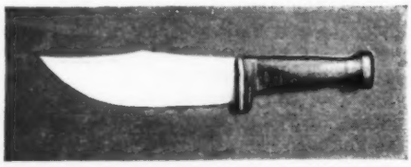
How to Forge a Hunting Knife from a Discarded File

By R. F. JENNINGS

EVERY man and boy who enjoys outdoor life learns to prize his hunting knife, and he values it all the more if it is one he made himself. The knife shown in the drawings below is an example of what can be done by any industrious boy of high school age who can handle tools and has access to a shop.

The blade is forged from an old flat file about 10 in. long, but it must be remembered that for the best cutting edge the steel must be heated slowly and never above a cherry red heat. Use a hot chisel to trim the blade. This will require much care and patience, but make every effort to obtain a good rough forging, a little oversize in every dimension except the shank. The shank can be forged to the exact size for threading with a 5/16-in. S.A.E. die. Finish the blade by grinding and filing it to dimensions and free from hammer marks. However, for safety's sake, the blade should be left dull as long as possible. All the file and grinder marks should be carefully removed with emery cloth.



The knife has a leather handle decorated with nickel trimmings and black and red fiber.

Next, the blade should be heat treated as noted at the top of the drawings. After being hardened, the blade can be polished, but sharpening should be left until later. At this point the entire cutting portion of the blade should be wrapped with friction tape.

Drilling the end knob to fit on the shank.

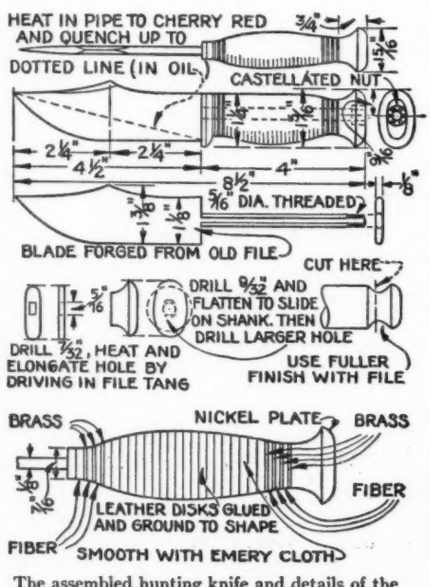
The crosspiece and end knob can be made from steel, brass, or copper.

The handle is made from pieces of sole leather or leather belting, drilled and forced over the shank, and later ground to shape on the emery wheel. Colored fiber and pieces of brass are used for trimmings at the ends.

After the handle has been assembled without glue it should be ground as closely to shape as possible on the emery wheel. Form the roughly forged end knob carefully to the shape indicated in the assembly drawing, and file and polish it. The blade then can be untaped and sharpened on an oilstone.

Now the handle can be disassembled, and the blade, crosspiece, and knob sent to the plater, if plating is desired. After being nickel plated or carefully polished, the handle should be glued up and the nut drawn tight. At this point the blade should be taped again after a piece of heavy folded cardboard has been placed over the cutting edge.

When the glue is dry, the handle can be trued upon the grinder and carefully smoothed with emery cloth. A final polish can be given the leather with a high-grade leather polish, and a leather sheath should be provided.

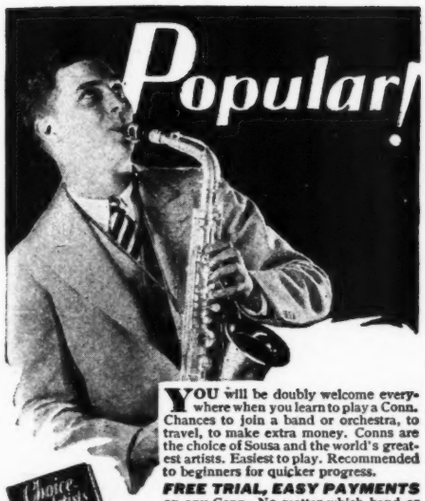


The assembled hunting knife and details of the blade, guard, end knob, and built-up handle.

RACK FOR SPARE BULBS

BY FASTENING to a long board a number of copper screw fittings taken from discarded electric light sockets, you can supply yourself with a convenient storage for spare bulbs. Screw the lamps into the fittings, where they will be in full view.—ERICH DALLMER.

The rack or holder is merely a board with a number of old screw sockets for the lamps.



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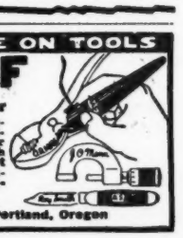

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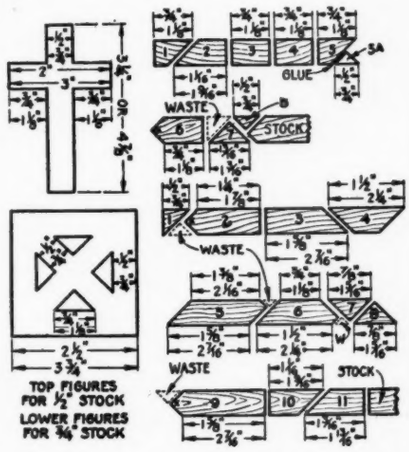
TWO PUZZLES THAT LOOK EASY—TRY THEM

LITTLE time needs be spent in preparing these simple block puzzles, for they can be cut from cardboard with a pair of scissors or from thin wood with a backsaw. Either ½ or ¾ in. wide stock may be used.

Be sure to make all of the cuts as shown and number each part as it is cut so that



All cuts are made at either right angles or forty-five degrees to the edge of the stock.

you may compare your solutions with the correct ones, which will be included in the August issue of POPULAR SCIENCE MONTHLY.

All of the pieces are shown right side up in the illustrations. It is well to color this side, using a different color for each puzzle. The points *X* are located in the exact center of the pieces as indicated, and all angles are at 45° to the edge of the stock.

In solving this type of puzzle, a full size outline drawn on a piece of heavy paper will assist greatly.

Next month, together with the solutions, two more block puzzles will be offered.—E. B. ROBERTS.

REPAIRING COMPOSITION SHINGLE ROOFING

WHEN composition shingles of the lighter and poorer grades have been used, high winds may cause trouble by driving the rain under them. This can be remedied by raising the shingles carefully and painting beneath them with a good grade of asphalt paint or the paint that is furnished with roll roofing and used to cement the joints. Apply the paint only where it will be covered by the shingles.

If the slate surface of shingles is worn off or badly discolored, it can be renewed with one of the various coatings sold for this purpose. If one of these is unobtainable locally, mix the following for each 100 sq. ft. of roof to be renewed: 1 gal. turpentine asphaltum, 1 gal. bright red, green, or other house paint, according to color of roof, and 1 qt. turpentine. Apply heavily and allow at least sixty hours between coats.

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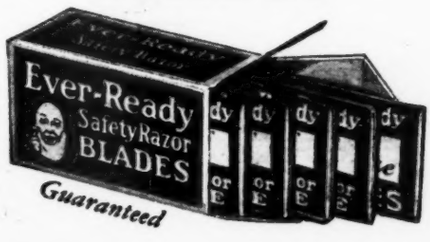

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It's a handout!

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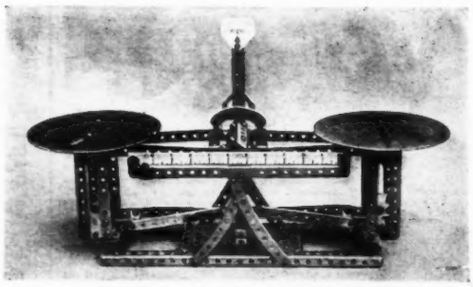
A SENSITIVE balance for general home laboratory work can be constructed easily and quickly from thin strips of wood or metal. The small strips furnished with various toy construction sets can be used and will simplify the construction greatly, since they have holes stamped in them at convenient distances and are also provided in a variety of lengths.



Three separate metal strip knife-edge supports give the balance a remarkable degree of sensitivity.

The base of the balance consists of a plate to which are attached the two central uprights that support the central knife-edge.

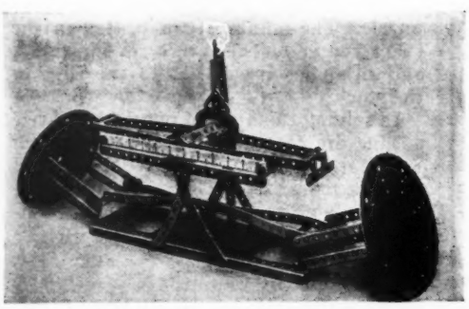
The upper or main beam, which consists of two strips bolted together, has an inverted V at its center and a knife-edge at each end. The center V rests on the center knife-edge, which is supported by the uprights.

This beam is provided with a vertical pointer or indicator. It also carries an auxiliary horizontal strip on which a small weight slides. On the auxiliary strip is placed a length of cardboard divided into ten major parts indicating grams. The correct sliding weight to be used will have to be found by trial.

Under the main beam a second beam is placed. This supports the pans, which are provided with inverted V-rests for the knife-edges on the ends of the main beam. The pans can be made any convenient size and shape and of any material desired.

Four strips connect each pan with the secondary or lower beam. These should be just long enough to allow the V-rests on the undersides of the pans to rest on the knife-edges on the ends of the main beam.

The three joints on the lower beam are loose, thus allowing the pan structures to pivot on the beam and the beam in turn to pivot on the center uprights.



Note construction of main or upper beam, the two knife-edges, the center support, and the lower beam.

When the scale is in a balanced position, both the upper and lower beams are perfectly horizontal. Both beams dip according to the weights placed on the two pans; and because of the knife-edges and pivots, the uprights are always vertical.

If correctly and accurately constructed, this scale can be used with precision up to a sensitivity limit of .25 grams and for weights up to 2 lbs.

To increase the sensitivity of the balance, razor blades can be substituted for the metal strip knife-edges. In this case, however, the weight limit will drop below 1 lb.

How to Make a Set of Marine Curves

NOT every amateur draftsman is able to pay the high price asked for a complete set of ship or French curves, but if he is handy with tools he can provide himself with an excellent set at about one twentieth of the price of the commercial curves.

All that is necessary is to be able to borrow a set of curves to copy. The process of reproducing them requires nothing more than the ability to follow lines closely with a sharp tool.

Purchase a sheet of celluloid about $\frac{3}{32}$ in. thick and tack it to a board. Take one of the curves from the set and drill holes in the sheet so as to match those in each end of the curve. Place the curve on the celluloid so that the holes coincide, and drive a wooden peg into each hole to fasten the curve in place.

The actual cutting is done with the point of a penknife, with the point of an engraving tool that has been ground to have a clearance angle of 45 degrees, or with a metal parting tool ground until it is about $\frac{1}{32}$ in. wide at the point.

Follow the curve closely and go over each cut several times. Remove the curve, turn the celluloid sheet over on the opposite side, and repeat the process.

The curves can be smoothed by using emery paper or sandpaper held over a small wooden block. Little sanding, however, should be attempted because of the danger of altering the curved contours.—ALFRED GEBER.

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Jumping from the Sky

(Continued from page 25)

that a parachute jumper never falls faster than 118 miles an hour no matter how far he drops.

Although this speed is nearly two miles a minute, I have never experienced any difficulty in breathing. I keep my mouth clamped shut and breathe through my nose. There is another reason for keeping my teeth set in a long jump. When you pull the ring and the 'chute blossoms, you slow down with a snap. Unless your teeth are set, the chances are that you will bite a piece out of your tongue.

IT DOESN'T make much difference how you get off a plane. You may be diving head-first to miss the tail, or turning somersaults. But your position does matter when you pull the 'chute open. In all styles of 'chutes, the main pull of the harness is on the shoulders. If you are dropping head downward when the 'chute blossoms, you will be snapped over in the fastest flipflop you ever saw. For this reason, I usually try to get as near upright as possible before jerking the ring. I can change my position in the air while falling by holding out a hand. The added resistance on that side turns me in the opposite direction. Once, in falling sidewise, I steered myself with one hand so I turned "barrel rolls" on the way down!

While such stunts should be attempted only after long experience in jumping, every airplane pilot should have parachute training. Lindbergh saved his life four times by trusting to parachutes. The total number of lives saved by 'chutes is between 200 and 300. They have rightly been called the "lifebelts of the air." Instruction in their use is as important to a flyer as instruction in launching lifeboats is to a seaman.

A year ago, the Navy parachute squad established a record when twelve men leaped from one airplane. Last summer, we set out to break that mark at Roosevelt Field. So sixteen of us got into a big Sikorsky biplane and at 2,000 feet I gave the signal. For the next fourteen seconds, a steady stream of parachute jumpers went out the door like bees from a hive. It made me dizzy to watch them. The Sikorsky, traveling at 100 miles an hour, planted parachutes in the sky clear across the field. I was the last man out and my 'chute opened so I faced the line. I began counting the parachutes and when I saw all were O.K. I had a grand ride to earth. We all landed safely.

MOST jumpers land safely these days. Accidents are decreasing. When a parachute fails to open, one of four things may be to blame. I have made a special study of these causes and give particular attention to them in instructing students in 'chute packing. Through incorrect packing, the lines may be tangled. The rubber cords may have been hooked up backwards so they do not open the pack when the ring is pulled. The rip cord may have become frayed so it breaks when it is jerked. The 'chute may have remained packed so long that the pins have become rusted or the cloth has lost its springiness.

Once a month, a parachute should be repacked by an expert. At Roosevelt Field, I pack about 100 parachutes a month. Each takes from a half to three quarters of an hour to complete.

The first jump, of course, is the worst. It takes only a moment to step off an airplane wing, but that moment probably is the longest of a lifetime. Most students start to get off several times before they leap. They step around on the wing as though it were hot. After this preliminary pawing, they all dive off. Three of my students were girls. Women are less hesitant than men. Tell them the 'chute is all right, and they dive off.

There are two ways of making a jump. One is to climb out on a *(Continued on page 120)*

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Jumping from the Sky

(Continued from page 119)

wing, open the 'chute, and let it pull you off. This is the easiest, but in some ways the most dangerous. If the 'chute accidentally opens and becomes tangled in the bracing wires, the plane will be pulled into a spin and nothing can save you. The second method is to dive overboard and then pull the ring. A jumper should count at least four before pulling the rip cord, as the 'chute strings up thirty or forty feet and may catch on the tail of the plane, tear, and pull the ship up into a stall and a spin. A novice should jump with his hand on the ring but be careful not to pull it too soon. I get off with my hands up in the air and in all sorts of positions and I have never had any trouble about finding the ring while falling.

ONE woman student made my hair stand on end last summer. I told her to count five before pulling the rip cord. She dropped and dropped. I thought she never would open the 'chute. Finally, it blossomed. I asked her how she counted. She said: "Like this, one"—pause of about a second—"two"—another long pause, etc. Something like a music teacher.

I gave an even worse scare than that to the crowds at Roosevelt Field, last fall. I wore three parachutes and jumped from 3,500 feet. I pulled open the first 'chute. It was fastened so it would tear loose, and I plunged on. The crowd thought I was a goner, sure. Then I opened the second 'chute. They breathed a sigh of relief. I let it tear away and dropped another three hundred feet before I ripped open the last 'chute, which was fastened on, and drifted down to an easy landing.

Last Easter, I had a grand time amusing the 15,000 people who came to the field to see Lindbergh come in on his record-breaking transcontinental hop. Randy Enslow, Lindbergh's old barnstorming partner, took me up, dressed in a rabbit costume with ears a yard long. I drifted right over the grandstands and wiggled the ears at the crowds as I sailed past.

Several times, when I have jumped with students, we have come down so close together that I could talk to them and give advice about landing. It is queer the way your voice sounds up in the air. There are no echoes. Your voice is flat. Sometimes, when I make jumps at the field on week-ends, I can hear the announcer telling the crowds about the jump while I am still a thousand feet in the air. The sounds which seem to penetrate upward clearest are the barking of dogs and the whistle of locomotives.

The latter sound once gave me the scare of my life. I was making a radio jump north of Roosevelt Field. Around my waist was strapped a miniature forty-pound broadcasting set. The average parachute weighs eighteen pounds. I weigh 160 pounds. So my twenty-eight-foot parachute was pretty heavily loaded and I dropped faster than I had expected. I was broadcasting away, telling everybody what a grand time I was having, when I heard the piercing whistle of a Long Island train rounding a curve a mile away.

I LOOKED down. In the grip of a powerful down-current the 'chute was drifting straight for the track. I tried to "slip" out of the descending draft, but this only increased the rate of descent. I loosened the harness straps across my legs, prepared to jump at the last second. After what seemed an hour, but probably was half a minute, the downcurrent ended with a bump. The descent slowed down and the 'chute sailed across the tracks two or three hundred feet in the air while the train roared past beneath me.

I decide where to get off a plane in order to land at a certain spot by noting the wind velocity and then figuring out how high and how far from the field *(Continued on page 121)*

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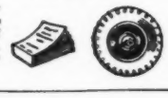

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Jumping from the Sky

(*Continued from page 120*)

I will have to be. The stronger the wind, of course, the farther the parachute drifts. I have jumped in thirty-five-mile winds. When I landed I was dragged a hundred yards before I could "spill" the air out of the 'chute by pulling back on the cords on one side. In coming to earth in a wind like that, you are traveling thirty-five miles an hour horizontally and dropping at the rate of about ten miles an hour. So you hit with a smack.

In a dead calm, I can almost bring a 'chute down on a quarter and have fifteen cents change. By pulling down on the lines on one side, I can make the parachute sideslip in that direction about ten feet for every hundred feet it drops.

However, the lines must not be pulled down too far in making a slip. If this is done, the parachute starts to spiral around the low side, winding up the lines and closing the mouth of the 'chute. If the winding continues, a parachute "spin" results. The 'chute pinwheels with the low side at, the center, the speed increasing rapidly.

THE fastest descent from plane to ground that I ever made was a 2,500-foot drop accomplished in sixty seconds. That meant an average vertical speed of about thirty miles an hour. I dropped 1,000 feet before pulling the rip cord. Then I slipped hard to within fifty feet of the field. When I let go of the lines, the 'chute opened fully at once and let me down for a gentle landing.

Exactly opposite was a jump I made this spring. I yanked the ring as soon as I got away from the plane and drifted down like a dandelion seed. The air seemed perfectly calm. It looked as though I would sit down gently enough to land on eggs. But at the last minute, just as I drifted over the hangars, a sudden downcurrent of air caught the 'chute and I landed with a whack.

Another unexpected ending to a jump was also due to a sudden gust out of what seemed to be still air. I had sailed along above a line of telephone poles beside a road. For perhaps an eighth of a mile I drifted exactly above those wires as though I were attached to them. About fifty feet above them, I slipped the 'chute to one side so I would come down in the road. But while I was looking at the road to see where I was going to land, the gust swung me back and I found myself sliding along the wires wearing little grooves in the seat of my trousers. I got loose from my harness in a split-second and sat there feeling foolish while one of the boys from the field got a ladder.

NIGHT descents have given me my weirdest experiences in 'chute jumping. I have made ten or more. I plunge through inky darkness, then jerk the ring and float down with all the tiny yellow lights of Long Island spread out below me. On the most exciting of these drops, I carried fireworks and set them off on the way down. As I swung the flares around my head, the fire and sparks were carried upward by the rush of air. They curved around the edge of the 'chute, forming a great question mark of fire in the darkness.

In recent years, improvements have been made in parachute design. Different shapes are being tried. The refinements are mainly in the direction of greater ease in steering and in greater speed in opening.

The other day, I figured up that putting all my jumps end on end I have fallen through the sky more than 100 miles. Stepping out of solid planes into thin air and rocketing downward at two miles a minute has become commonplace. Yet, my only injury has been a sprained ankle. Parachutes may not be as safe as rocking-chairs, but they have been good to me. And they have given me seven years of thrilling adventure.

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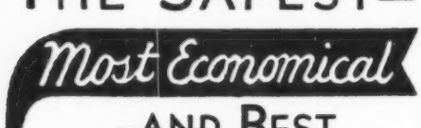

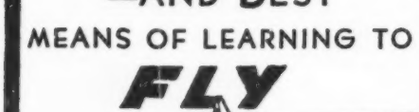

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Picking a Gliding Site

(Continued from page 59)

Every corner of the west ridge must be utilized to advantage. The calm will come to an end. Meter by meter it is dragging me down. A desperate battle. I want to make a second turn at the edge where ordinarily the best upwind is encountered. Suddenly I notice that the ridge alongside of me drops. Hurrah! I am rising. Wind at last. In less than two minutes, I rise over the starting point, circle about and land 150 meters to the rear in the wind of the west ridge. The whole flight has lasted thirty minutes."

When the wind dies down, the soaring pilot must land. He is as dependent upon the breeze as is the helmsman of a sailboat. Consequently, steady winds are a requisite of a soaring site. Inshore breezes, such as prevail along the California coast, are particularly valuable.

IT WAS such a sea breeze that kept W. Hawley Bowlus swinging in steady circles over Point Loma, California, for nine hours and five minutes recently when he established a new American endurance record (P. S. M., Jun. '30, p, 40). A wind that varied between eighteen and twenty miles an hour blew steadily throughout the journey. When it died down, Bowlus spiraled to a gentle landing on the roadway from which he had taken off more than a third of a day before.

In looking for soaring territory, seven rules should guide the search.

First. Ridges are better than isolated hills. The best ones are curving and fifteen or more miles in length with the concave side facing the prevailing wind. If possible, a series of ridges running parallel to each other should be selected. Each will cause a rising air current so the soaring plane can glide from one to the other and sail across country for miles.

Second. The starting elevation should be from several hundred feet to fifteen hundred feet high. The slopes must be no steeper than forty percent; that is, having no more than a four-foot drop in ten feet. Steep bluffs and cliffs are dangerous. They should be avoided in taking off. The air currents striking a vertical cliff eddy about, forming downdrafts near its face. Unless the soaring plane is shot out into the rising air beyond these downdrafts, it will be caught and plunged to the ground.

Third. The slope of the selected ridge should be as free of obstacles as possible. Ideally, it should be clear from top to bottom. At least, it should have cleared "alleys," about 200 feet wide, running down the sides to provide for emergency landings. At the top of the take-off ridge an open space of four or five acres is needed for launching the wide-winged soaring craft.

Fourth. The elevation selected should overlook a wide valley. In the case of several parallel ridges, the distance between them should be at least three times their height. Otherwise, the windward ridge will "kill" the breeze. In selecting a soaring hill, the foreground should always be given careful consideration. If it has many obstructions in the direction from which the prevailing wind blows, the air will be disturbed. One reason seacoasts have proved excellent soaring spots is that the air currents, sweeping in from the level surface of the water, are not disturbed as is the case when they pass over trees, woods, and buildings on land.

Fifth. The average wind velocity in soaring country should be between eight and twenty-five miles an hour. However, many of the famous flights have been made in winds that exceeded that limit. Last summer, at Cape Cod, Rolph von Chlingensperg, an instructor at the school of the American Motorless Aviation Corporation, flew for two hours and seven minutes in a thirty-one-mile wind during a rainstorm. When Dinort made his fourteen-hour-forty-six-minute world's record, he weathered blasts that reached forty and fifty miles an hour and rode out a violent storm that came sweeping in from the Baltic.

Sixth. In selecting a spot for soaring, note the direction of the prevailing wind. The ridges should always face the direction from which the wind most frequently blows.

Seventh. Accessibility is important. There should be good roads leading to the selected field so machines and equipment can be transported easily to the starting ground.

Locations that combine all seven requisites are scarce. One of the strangest soaring spots, where remarkable flights have been accomplished, lies on the northern edge of the Sahara Desert, near Biskra, Algeria. A long chain of hills form a horseshoe-shaped bay that faces the desert. Above this bay, the French lieutenant, Thoret, made his amazing "hot air" glider flights a few years ago.

In the heat of the day, the shimmering air rising from the sand forms lifting currents sufficiently strong to carry aloft a sailplane. In fact, so powerful are some of these columns of rising air that Thoret is reported to have flown over the half-circle of hills in a motored Hanriot monoplane and to have cut off his motor and soared the heavy plane for more than an hour. Later, a number of long flights in motorless machines were made over the territory. While sustained trips may be achieved under such conditions, the fourteen-hour record could not be equaled since with the coming of night the desert cools and the heat waves stop.

Not only above deserts, but over ordinary country as well, heated air forms rising currents. The "bumps" met in airplane flying are usually caused by these updrafts. The difference in the amount of heat given off by various types of fields when the sun shines upon them is the cause of such currents. A sandy stretch, for example, gets hotter than pasture land and a field of grain radiates more heat than woods. Above the hotter fields columns of rising air are formed. In soaring across country, the glider pilot is often aided by such lifting currents.

SUCCESS as a flyer of soaring ships depends largely upon a knowledge of air currents. The great soaring pilots of the world have an almost uncanny ability to sense the location and strength of an updraft. A study of these currents can be made by anyone. By watching birds and noting how they are affected by winds and upgusts and by lighting smudges on hillsides and watching the path of the smoke as it is carried over the hill, valuable information can be obtained. Such simple observations, which can be made without cost, will give a foundation of knowledge that will aid later in piloting sailplanes through the sky.

Our present understanding of the effect of heat and hills and clouds upon air-currents is relatively slight. We have just begun to use the power of these invisible swirls and streams in the sky. Not long ago, W. H. Bowlus predicted that some day we will ride these air waves from coast to coast in motorless machines. If that dream comes true, it will be largely the result of a more perfect understanding of air currents and their use. And in bringing about that understanding, every glider enthusiast can play his part.

ASSEN JORDANOFF, famous war-bird and flying instructor, tells in a forthcoming issue of POPULAR SCIENCE MONTHLY his experiences in piloting modern gliders and soaring ships. His article is packed with interesting anecdotes and valuable information. Watch for it. It is the sort of an article you will clip out and save. Don't miss it.

World's History in One Picture

(*Continued from page 40*)

in the Oriental civilizations of Egypt, Chaldea, China, and India, especially in the two latter. Compare this with the sudden rise and swift fall of Greece and Rome. If an average were taken for the entire period shown, the Oriental cultures would rate higher than the Greek and Roman, which for a short period soared above them. It would be, to a visitor from another planet, a question as to which in reality had given the better value to the race as a whole, especially taking into consideration the fact that the Chinese, Japanese, and Hindu peoples are at present showing vigorous evidence that they are by no means degenerate and vanishing races.

An interesting sidelight on the proportionate values of history as it has been taught arises from consideration of the importance in the graph of the Persian Empire. Most of us have been accustomed to think of this empire as one of the greatest and most powerful in history. In a sense this is true; but one glance at the graph brings a realization of its extremely short life in comparison with others. Perhaps our impression has been due to the current method of teaching history as a series of spectacular highlights further emphasized by certain eminent historians who specialized in their details. Had it not been for Alexander the Great and the Greek writers of history, we might know little more of the Persian Empire of Cyrus than we do of the far more enduring civilization of Crete.

Visualizing graphically the uprush of modern European culture—including America's, for Americans are of comparatively recent European origin in such a survey of centuries—we are forced to wonder if it bears too much resemblance to the careers of Greece and Rome. Will the historian of A. D. 3,000 draw his graph of our civilization in a similar, though loftier curve, while the lines of the despised Oriental races meander on calmly as they have since the first records of man were chiseled in stone?

Talk, Hear, See on This Phone

(*Continued from page 22*)

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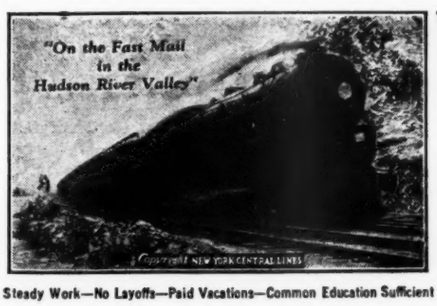

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Strange Dreams Made to Order

(*Continued from page 28*)

lem we coped with was that of producing a typical dream such as the familiar "falling" dream. The principal difficulty, of course, was discovering the stimulus needed to arouse this dream. In thinking over the matter we decided that this dream must have a commonplace cause, otherwise so many people would not report having it. It also seemed probable that such a dream might be linked up with the actual experience of having one's bodily equilibrium disturbed. An instance of such a probable stimulus would be a sudden though slight drop of a part of the body as the sleeper shifts his position.

PUTTING this "guess" to experimental test was an easy matter. The subject was a young girl. For fear of interfering with the success of the test, we kept her in ignorance of our real purpose. All that she was told was that the experiment had to do with a study of muscular relaxation. After she was hypnotized we had her lie down on an Army cot in a comfortable position with her head resting on a pillow. A slight, sudden pressure of the cot alongside her ankles was then applied. For a brief moment her feet, thus depressed, were lower than her head. Her dream response was a gratifying confirmation of our "guess."

"Did you have a dream?" we inquired.

"Yes. I dreamed I was sliding down, sliding down a chute-the-chute."

We tried this type of stimulation on another subject, a young man. Out of eleven attempts we secured eleven dreams of falling. We found that the direction in which the dreamer finds himself falling can be controlled by the experimenter. A slight pressure on both sides of the cot at the level of the sleeper's waist produced a dream of being shoved under water. A downward pressure of the pillow on the left side of the subject's head made him dream he was falling into a cellar, head down, and whirling to the *left*. It is well to note that the pressure was not at all violent. A slight depression of the pillow or mattress is enough to give rise to the falling dream.

A question sometimes put to the psychologist is "Why does the same dream recur on different nights?" Our investigation suggests a helpful answer. In the course of the experiments we took occasion to use the same stimulus over and over again on some subjects and found that we could arouse the same dream this way even though several days separated the experimental sessions. On repeated trials the man who dreamt the black rat bit his hand would report the same dream whenever his hand was pinched with calipers. Other stimuli applied to other subjects gave similar results.

THIS does not mean that different people have the same dreams in response to the same stimuli. The dream is a matter of each individual's past experience. Five of our subjects were stimulated by means of a light stroking of the skin of the hand with soft cotton. As we just stated, this stimulus made one young man dream of having his hand licked by a cow. The same stimulus caused a second subject to report:

"I was in bed in the hospital and my girl came to see me. She was sitting by the side of my bed holding my hand, caressing it with hers."

The third subject felt a "big shaggy dog" rubbing against his hand while another dreamed of playing with an angora cat that was rubbing against her arm.

Differences of the same sort were revealed in connection with the use of the tuning-fork as a stimulus. The sound made one subject dream of the whirring of airplane motors. Another dreamed that "a hand rolled a dollar down the road and the eagle flew off." A third dreamed he was in a submarine and heard an oscillator signal.

On one occasion we endeavored to see what would happen when the hypnotized subject was presented with a number of stimuli in quick succession. We had him smell some perfume first; then we touched his forehead for a moment with the sharp end of a whisk broom; followed the latter by throwing open his pajama coat and immediately replacing it so that his chest was exposed for an instant; and finally blew on an organ pipe for one second. The dream produced by this medley of stimuli was somewhat remarkable and can best be stated in the subject's own words:

"I see a dresser, clock on one side, a woman's dresser. Smell perfume and powder. A little boy came in and blew a horn and ran out. That's all. A mosquito bit me on the forehead. Believe I was dressing. Clothes are not buttoned yet."

A DREAM of this sort suggests the possibility of many *fantastic* dreams being the result of the mind's endeavor to interpret and reconcile successive stimuli experienced during sleep. Our experiments also indicate the way in which several stimuli given at the same time, simultaneous stimuli, may result in bizarre dreams. For example, the subject who always dreamed of the black rat when his hand was pinched, usually dreamed of a hospital when stimulated by the odor of creosote. But when these stimuli were presented *together* he dreamed that a bearded doctor, wearing glasses, dressed in a black suit, and having long finger nails, sewed up a cut in his hand.

With reference to the duration of the dream, we have secured the time in eighty-four cases. The average time, we found, is about thirty seconds. The young man's dream of the automobile accident produced in response to the stimulus of the word "Help!" lasted exactly twenty seconds. The shortest dream we have timed so far was one that lasted for five seconds, while the longest required about ninety seconds. These measures, it should be understood, are by no means either absolute or final. They will doubtless have to be revised as more and more dreams are timed.

One additional question upon which our experiments shed some light is that of "dreamless sleep." Is it possible for a person to dream and forget the dream (or dreams) so completely that upon awakening he insists his sleep was utterly dreamless? In other words, can we be sure we had no dreams just because we have no recollection of them?

In the light of our work the answer to this question must be no. We found, for example, that the subject who dreamed about the black rat could not remember his dream after he was roused from his hypnotic sleep.

IT IS also of interest to note that this subject reported never having experienced any dreams at all at night in the last four or five years. Possibly in many cases we dream far more than we realize in the light of our wide-awake effort to recall the events of the night. Most of our subjects, though, did remember their dreams.

There is much more to be said about this problem as well as the others we have outlined. Indeed there are numerous problems tied up with the subject of dreams that we have had to omit in such a short account as this one. Our chief purpose has been to show how the technique, presented here, promises to furnish the psychologists with a method that may answer many timeworn enigmas so that the whole problem of the nature and meaning of dreams may be taken out of the realm of speculation and placed under scientific control.

New Ways to Cure Radio Fading

(*Continued from page 71*)

.0001-mfd. condenser. An ordinary .00025-mfd. grid condenser also can be used. *C2* is a by-pass condenser which should have a value of ½ to 1 microfarad. *R1* is a two-megohm grid leak. *R2* should have a value of from 75,000 to 100,000 ohms. The potentiometer, *P2*, should have a resistance of 50,000 ohms. The parts comprising this circuit can be made up on a small board and placed in the radio set in such a position that the lead marked "to plate of last radio-frequency tube" is just as short as possible. A long lead at this point will cause all kinds of trouble.

It is assumed that the automatic volume control will not be applied to a set unless it is a powerful outfit with at least three stages of radio-frequency amplification. There is no use in attempting to use an automatic volume control on a set having low radio-frequency amplification.

THE lead marked "to ground" should be attached to the metal framework of the radio chassis at the nearest convenient point. The lead marked "to F side of radio-frequency coils" should be connected to each one of the radio-frequency coils by ungrounding the end that is normally grounded. Much better results will be obtained if each coil terminal is grounded by a 1/10 to ¼ microfarad fixed condenser placed as nearly as possible in the location occupied by the wire which originally grounded the end of the coil.

In order to avoid complication in the circuit a separate 45-volt B battery should be used applied to the binding posts indicated. Switch *S* is included in the circuit so that the current can be shut off from the potentiometer, *P2*, when the set is turned off so that the 45-volt B battery will not be run down needlessly. The 2½-volt lead can, of course, be connected into the 2½-volt circuit in the set.

The battery operated volume control unit shown in Figure 2 is essentially the same circuit. The same parts are used except the tubes, tube sockets, and an extra switch, which is needed so that both the A current and the B current can be shut off.

IT IS necessary in this circuit to use a separate A battery and also a separate B battery, and if no 6-volt storage battery is available to the experimenter aside from the one he is using on his set it is possible to use the UX-199 type tube with equally good results and apply three No. 6 dry cells in series connected to the A binding post. *P1* is an ordinary rheostat—20 ohms for 201A tube, 30 ohms for 199 tube.

In putting either of these two automatic volume control circuits into operation it is necessary to adjust potentiometer *P2* so that the tubes will be operating at their normal bias when no signal is being received. Before applying the automatic volume control, therefore, measure the plate current of one of the radio-frequency tubes. Then after applying the automatic volume control, set potentiometer *P2* so that the plate current of the same tube is equal to the flow without the volume control. This adjustment should be made with the antenna grounded.

Note that the automatic volume control is operated by the carrier wave of the station being received and not the actual modulated signal; in other words, the automatic volume control goes into operation and regulates according to the strength of the carrier wave of the station to which the set is tuned.

The broadcast signal is impressed on the carrier wave at the broadcast station, and as the volume control is not affected by the degree that the carrier wave is modulated, differences in local station volume will be due to variation in modulation.

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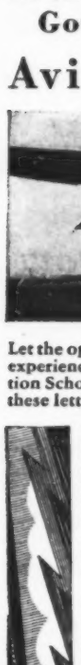

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New Ways of Probing for Gold

(*Continued from page 42*)

gold pan, why not use scientific instruments in detecting ore bodies that are hidden beneath the surface of the earth?

In Sweden, magnetic prospecting for iron ore had been successful in the beginning of the seventeenth century. A century later, bodies of iron ore were located in New York and New Jersey by the same method. The first electrical prospecting in this country was tried on the celebrated Comstock Lode in Nevada in 1882, but it was not followed up, as plenty of discoveries were being made at the surface by simpler methods.

DURING and after the World War, geophysical prospecting, as it is called, made rapid strides. This form of prospecting means a search for mineral and oil deposits by electrical, radioactive, magnetic, gravitational, or seismic means. The war itself helped the geophysicist work out some of his problems. Seismologists, with their shock-recording instruments, originally developed to record earthquakes, were enabled to locate hidden enemy batteries by the refraction of sound waves through the earth. The same principle is now applied to the discovery of salt domes in the Gulf oil fields and can be used, to a limited degree, in the location of hidden ore bodies. The principle of locating submerged submarines through their magnetic qualities is being utilized in the location of highly magnetized bodies of ore.

Not less than 1,000 men, it is estimated, are engaged in modern scientific prospecting in North America today. In addition there is a secondary army, much larger in numbers, consisting of laborers needed in transportation, clearing survey trails, and other work connected with the new prospecting. Many firms in this country and elsewhere are engaged in the manufacture of equipment. The magnetometers, torsion balances, and other instruments used by these experts in the prospecting field on this continent are valued at not less than $1,250,000.

Geophysical prospecting can be done rapidly. From five acres to one hundred acres a day can be covered, according to the character of the country and the type of prospecting being done. Seasonal conditions do not affect this kind of prospecting, except as to the comfort of the operators. Snow on the ground does not prevent the use of the induction method of electrical prospecting, and ice on a lake actually forms a convenient means of prospecting the ground below. A large body of copper-bearing pyrites was discovered under an ice-covered lake in Sweden by the induction method several years ago.

EACH of the methods of scientific prospecting has its practical application in the search for ore bodies, but some have proved more widely effective than others. The gravitometric method, as its name indicates, is based on the law of gravitation. The instrument used, called the torsion balance, indicates minute variations in the gravitational "pull" of the earth, due to materials below the surface which are heavier or lighter than the rocks normally present. This method is of great use in the location of oil and salt deposits and also in prospecting for coal. It is best applied in flat countries where the general geology is known. While ore bodies can be located by this method, much time is required.

The seismic method, in which the seismograph is used for recording sound waves, is, like the gravitometric method, chiefly useful in locating oil and salt deposits. This method is used to determine the vertical distance down to a certain formation.

The magnetic method is based on the well-known fact that electrical currents are always flowing through the ground. Certain types of ore bodies generate their own electrical field, Nature thus rendering assistance in the search. For instance, the oxidation near the surface of a bed of sulphide ore—gold frequently being found in sulphides—establishes a current like a dry cell. Detecting and measuring to determine the source of this current is the oldest form of electrical prospecting. Much experience is needed by the operator in reading, and the fields surveyed by this method must have pronounced electrical or magnetic properties.

In the system of electrical prospecting now generally used, the prospector goes a step beyond Nature. He creates an electrical current which he sends into the earth, and then uses delicate instruments to find out what happens to the current. A current of electricity, like water, takes the easiest path. If such a current is forced to flow through a block of ground composed of earth or rock which incloses a body of highly conductive mineral, the bulk of the current will pass through that mineralized body, because it will find less resistance than in the highly resistant rock. Thus a check on the path taken by the electric current through a plot of ground containing an ore body will show the electric current converging toward that body of ore.

TO CREATE this current, two parallel copper wires are stretched along the ground as electrodes, earth contact being made with iron staples set close together. These wires may be as much as a mile long and laid a mile apart, although in most cases they are much shorter and are seldom more than 500 feet apart. One end of each cable is connected to a source of alternating current, and the current is turned on. If no part of the ground is more highly conductive than the rest, the current flows from one wire to the other in uniformly straight lines.

To determine the distribution of current in the ground, a telephone receiver in circuit with two iron rods, called a "flying circuit", is used. With one rod planted at a certain point, the operator probes the ground with the other rod until he finds a point where no sound is heard in the telephone. Thus he knows that he has located points between which no current is flowing. The point is then marked by a stake, the other rod is moved up, and the observer proceeds to locate another pair of points. Where a mass of conductivity superior to the rest of the ground exists, the current flow through the ground will be distorted. Lines that follow the current flow will show this distortion when transferred to a map. In exceptional cases the distortion of the current flow lines may locate the ore body within a few feet. This is a brief description of the Swedish method, which is being widely used all over the world.

SUCH surveys have been made above placer deposits in California, Colorado, and British Columbia, and above the beach deposits of placer gold at Nome, Alaska. So successful were some of these surveys that in several instances certain pay values of sand per cubic yard were determined in advance of mining operations.

The work of the new prospector is, in a sense, a diagnosis. He tells of certain conditions beneath the surface of the earth which indicate the presence of ore. It remains for the diamond drill or actual digging to determine if the ore is in paying quantities. It is a common saying, as applied to mining, that more money is put into the ground than is taken out of it. The scientific prospector is in a position to save the world much useless expenditure in searching for ore that does not exist; for, if the ground is barren, tests (*Continued on page 127*)

New Ways of Probing Old Earth for Gold

(*Continued from page 126*)

show it. Sometimes it happens that negative reports are not sufficient to outweigh the faith of claim owners in the value of their property.

"A Canadian mining company called us in to do some prospecting," said the head of a leading electrical prospecting firm in New York. "The company had acquired a vast acreage adjoining its operating mine. The officers of the company were strongly of the belief that this acreage was all heavily mineralized—that all they had to do was open it up and have one big mine. We made a thorough electrical survey of the property. One negative report after another was turned in. Our operators could not detect the presence of any ore-bearing bodies. The officers were not inclined to accept our report. Since then they have spent many thousands of dollars in digging, but they have not struck any ore."

THE advance of the new prospecting does not mean that prospectors of the old school will be crowded out of the field. Men of courage and faith will play their part in gold discoveries of the future. But they will have new and undreamed-of competition in prospectors who are armed not only with technical knowledge but with sensitive instruments which minimize the truth of the ancient saying: "Beyond the pick all is dark."

Millions Use New Covered Wagon

(*Continued from page 57*)

out upon the Connecticut country air. When, at midnight, the rest stop at Darien, Conn., was reached, the ice was broken completely.

Through all this, our driver, a clear-eyed, clean-cut young fellow, sat silently at the wheel. Thoroughly businesslike, his eyes on the road ahead of him, he took no part whatever in the passengers' sociability.

He was typical of the thousands of men to whom millions of Americans entrust their lives on the highroads today. For bus transportation not only has developed a new kind of passenger; it also has produced a new type of driver. The motor coach pilot is the engineer, conductor, mechanic, and baggage master of his bus. Only on the sleeper coaches on the west coast and now between Chicago and Detroit and St. Louis and Kansas City is there a second man in the "crew"—the chef. The driver, then, must be an experienced chauffeur, a motor expert, and know how to deal with the public as well. As a result, he invariably is an alert young man of more than average intelligence and with pleasing manners.

EXTREMELY jealous of the safety of their patrons, the bus companies have organized elaborate systems to select, train, and supervise these men.

Here, for instance, is the method of the Greyhound Lines: Men over thirty-five, E. W. Bogan, regional manager of the company at New York, told me, usually are not encouraged; boys under twenty-one and men over forty are not accepted. Preference is given high school graduates and there are even a number of university men in the ranks.

Generally, about nine months elapse from the time a man applies until he is given a run as a full-fledged driver. The applicant undergoes two physical examinations, one for general fitness and the other by eye and ear specialists. If he passes, he is enrolled in the company's training school. Here, he first receives a three-weeks' course in driving and then a two-weeks' course in

(*Continued on page 128*)

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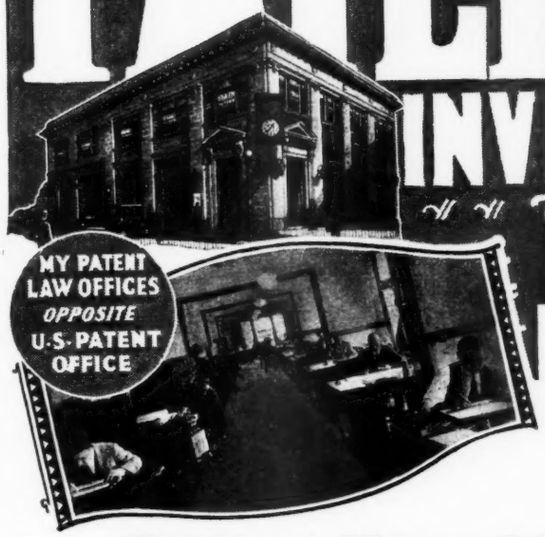

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Millions Use New Covered Wagon

(*Continued from page 127*)

business routine—the management of tickets and money and the rules for contact with the traveling public.

After that, the new driver is put on the "extra board." For some months he makes short runs, substitutes for men who are ill and on vacation, and so forth. After finishing this trial period satisfactorily, he finally is given a full-time job.

The maximum number of miles the men drive varies, according to the nature of the division, from 150 to about 200 miles a day. Experts constantly analyze and test the working conditions, so that a man, if possible, never has to drive beyond a point where either nerve or eye fatigue sets in. Thus, on long-distance trips, the drivers are changed more often than the buses.

MARCUS DOW, formerly Deputy Commissioner of the New York Police Department and president of the National Safety Council, is director of safety for the company. He has devised an elaborate system to check up on the drivers. Supervisors in light cars constantly patrol every mile of the routes. They, in turn, are responsible to the superintendents. The "safety men" investigate and report every accident, and even a nick on a fender is classed as a mishap.

The magnitude of this job may be realized when it is remembered that the Greyhound Lines cover 36,000 miles of road, and that last year 2,264 Greyhound buses carried 18,000,000 passengers a total of 100,000,000 miles! But the results justify these efforts. Accidents are rare. The company's safety record is held by the Pittsburgh division with 12,000,000 passengers carried in four years without a single fatality.

Safety is the watchword not only of this but of all bus companies. The drivers must stay within the speed limits prescribed by the states and municipalities through which they travel, but they are not allowed to exceed forty miles. The average bus speed is twenty-five miles an hour. The cardinal rule for drivers with all companies is: Stop at railroad crossings.

The men are under orders to disregard schedules in case of sleet storms and other bad weather conditions. Likewise, though there is no rule upon this point, it is traditional that they stop to help other motorists in distress.

THE bus driver is expected to cope with all ordinary cases of motor trouble. If a serious breakdown occurs, a relief bus is sent from the nearest station. This, however, happens rarely. Up-to-the-minute servicing methods have reduced such accidents to a minimum.

To forestall failures and to secure a life expectancy of at least 300,000 miles per bus, the big companies have established maintenance shops where all units are completely overhauled systematically and according to a definite schedule.

The largest of these is the new plant of the Mitten Management in Philadelphia. Covering a ground area of ten and one half acres and with a floor space of 110,000 square feet, it is the biggest bus shop in America and probably the largest single shop devoted exclusively to automotive repairs in the world.

Here, seventy-five buses of the company's fleet of 570 vehicles can be serviced simultaneously. The plant also has provisions for handling a continuous flow of engines, electrical units, axles, and the like, sent in from eight different operating garages in various stages of disrepair. The shop employs a force of 181 men.

According to H. B. Hewitt, general superintendent, the following is the expected annual capacity of this giant repair shop—600 completely overhauled buses; (*Continued on page 129*)

Millions Use New Covered Wagon

(Continued from page 128)

500 complete paint jobs; 600 rebuilt engines; 3,200 sets of relined brakes; 2,000 power motors overhauled; 1,000 power generators overhauled; 500 distributors and coils rebuilt; 400 batteries partly and wholly rebuilt; 2,000 universal joints rebuilt; 600 steering gears overhauled; 650 sets of bus seats reupholstered; 650 sets of window sash rebuilt; 600 front axles rebuilt; 600 rear axles overhauled.

Not long ago, at the Providence, R. I., garage of the New England Transportation Company, the bus subsidiary of the New York, New Haven, and Hartford Railroad, a bus was completely rebuilt by twelve men in seven hours and forty minutes, a record for a thorough motor coach overhaul and one which, in the opinion of experts, will probably stand for some time to come.

THE job was done as a test of servicing efficiency before an invited group of railway and bus officials. Buses of the New England Transportation Company are completely rebuilt after 60,000 miles of service. At 7:55 o'clock on the morning of the demonstration, a twenty-nine-passenger parlor type bus pulled into the garage after its regular run from Boston. Its odometer showed a total of 67,800 miles since the last overhaul. At 4:30 that afternoon, the coach was off again on its regular trip to Boston with a dozen passengers. In the meantime, every single unit of its chassis had been renewed to insure uninterrupted service for another 60,000 miles. The body, too, was overhauled thoroughly. Not a single detail was overlooked; even the window drapes had been cleaned, repaired, and rehung.

With servicing such as this, the average life of a bus, costing from $13,000 to $15,000, is 300,000 miles, or a period of from three to four years. Nowadays, balloon tires are used almost exclusively. They deliver from 20,000 to 25,000 miles of service over a period of about three months. As for gasoline consumption, that is enormous—the motors require more than a gallon for every five miles they run. With a total mileage of 100,000,000, the Greyhound system alone last year consumed 19,000,000 gallons of gas!

Most motor buses, especially those in long-distance service, are powered by six-cylinder gas engines, developing from 100 to 175 horsepower, depending upon the capacity of the coach, which ranges from twenty-five to thirty-three passengers.

SEVENTY-ONE years ago, the first stagecoach to California drove westward out of the frontier town of St. Louis. Today, more than a thousand de luxe motor buses run from the Atlantic to the Pacific, each a swift and shining piece of evidence of America's rapid progress in the field of transportation.

Device to End Career of Hit-and-Run Driver

HIT-AND-RUN drivers, those phantoms of the traffic drama who so often make mysterious get-aways, have a rapidly diminishing chance of escape in the future, to judge from the number of mechanisms that are at present being invented to aid in their capture.

The latest contrivance is by a New Jersey lawyer, who has devised a "bumper" apparatus that flings the culprit's license number far and wide whenever his car is in a collision. A tube about an inch in diameter, attached to the front bumper of the car, shoots a shotgun-like spray of twenty-five paper disks into the air whenever the bumper is heavily jarred. A trigger discharges the tube. The disks betray the owner of the car, since his license number is printed on them.

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Genius Crushed by Patent Laws

(Continued from page 44)

in fighting interference proceedings in the Patent Office, and in each case the other man was not only second in the Patent Office, but has never alleged that he invented the device before the time that I filed my application. His alleged date of conception in these various cases was in all of them subsequent to my date of filing, and yet I have been forced to spend enormous sums of money in these interference proceedings."

Another inventor was forced to spend $60,000 in six years in a single interference case. The average man who applies for a patent is practically helpless if he is faced by a rich organization that can carry on appeals for years in such a suit. Usually, the poor inventor, who cannot withstand the financial strain of interference proceedings, compromises and settles the case. The papers are reworded to the advantage of his opponent.

IN describing the needlessly complex procedure of these suits, the Court of Appeals of the District of Columbia went on record with this statement:

"From the simple and summary mode first adopted for determining the question of priority of invention, that proceeding, by system of Patent Office rules, has grown to be a veritable Old Man of the Sea, and the unfortunate inventor who becomes involved therein is a second Sindbad the Sailor. It is known to all who are familiar with the practice in interference proceedings that by motions, petitions, and appeals of every conceivable character that the ingenuity of the skilled attorney can devise, interferences can be and are prolonged for years, to the injury of the public, and often to the financial ruin of the parties."

Such drawn-out and unnecessary litigation should be made impossible if inventors are to be properly protected. Thomas A. Edison has taken this stand: "The first inventor who shall file a clear and accurate description of his invention, which the Patent Office shall find to be new, useful, commercially practical, and unknown before the date of filing, should have the patent." If such a procedure were adopted, it would mean that interference cases would never occur and inventors would be saved vast sums and needless delays. Provisions regulating fraud would insure the issuance of the patent to the actual inventor and not to someone who had stolen the idea.

The injustice of such delays is increased by still another defect in our present patent laws. All the time that an applicant is waiting for his petition to be considered, and all the time he is waiting for the settlement of interference suits, others can make and sell his invention and he is helpless. He cannot sue for infringement until his patent is issued. Inventors should be protected by law so they could collect back royalties when it is proved that someone used their ideas after notice was served that a patent had been applied for.

With more than a million and a half patents piled up in the search rooms of the Patent Office in Washington, and with more pouring in every day, the chance of getting an invalid patent, because some previous one has been overlooked, increases all the time. Yet, even after you get a valid patent, you may find it is practically worthless.

Suppose a man by the name of Arthur Johnson makes the first dishwashing machine and obtains a patent upon his broad, basic idea. Several years later, another man, George Smith, who has never even heard of Johnson's dishwashing machine, sets to work and invents a dishwashing machine of his own which, unlike Johnson's machine, utilizes live steam to clean the dishes. He clearly has made an improvement, and if all his claims mention the live steam feature, his patent will be issued without any mention of the Johnson dishwashing machine.

So Smith starts putting his live steam dishwashing machine on the market. He prospers until one day Johnson's lawyer puts in an appearance with an injunction prohibiting him from making any more dishwashing machines.

"But, look here," Smith says, pulling out his patent papers, "my patent grants me the exclusive right to make, use and vend my invention throughout the United States."

"Maybe it does," replies the lawyer, "But Johnson's patent grants *him* the same right with respect to *his* invention. And, as his grant is earlier and broader than yours, your patent is subject to his prior rights."

The only thing that Smith can do is to offer to license Johnson to make the improved machines. In return, he can get a cross-license, entitling him to make his own invention. For Johnson, by virtue of having a patent on the basic idea of dishwashing machines, can prevent anyone else from making any sort of a machine for dishwashing. Smith, by obtaining his patent, can prevent anyone else, including Johnson, from making the live steam dishwashers. However, this does not allow him to make them himself!

Although they do not say so, all patents are granted "subject to the prior rights of others." A large proportion of all inventions patented cannot be manufactured without a license from the holder of some other previous patent. The validity of a patent signifies little as to its value. The misleading statement which appears on all patents should be amended to read "the exclusive right to make, use, and vend—subject to prior patents." Moreover, all previous patents which will interfere with the free manufacture of [the invention should be cited by the examiner.

Every patent attorney tries to draw up an application as broad as possible. However, for several reasons, there is danger in making the claims too broad. The chances of interference are greater. Also, if the claims are not sufficiently definite, the result may be a patent which will not be clear enough to win in interference suits.

On the other hand, it is easy to make the claims so narrow they do not afford adequate protection. When, some years ago, the inventor of a new kind of excavating dipper applied for a patent, he made one of his claims cover "a two-part dipper, one part being rigidly held, and the other part being hinged thereto." The examiner rightly held that the claim was incomplete, not stating what held the rigid part. So the inventor changed the claim by adding "a dipper handle." In this way, the patent was issued. As a result, his patent does not protect him against a similar dipper supported on a trolley. If he had said, instead, "a supporting member," thus less completely limiting the invention, he would have been fully protected.

BECAUSE of the maze of laws and rulings, of technicalities and delays that an inventor has to encounter, many are asking themselves not: "How can I get a patent?" but: "Is it worth while to get a patent?"

Practically every year for the past two decades, there have been one or two bills before Congress designed to remedy the present inadequate and discouraging system. The need for change is universally recognized. Yet, virtually no relief has been given the American inventor.

If such relief arrives, it must come through agitation by the readers of POPULAR SCIENCE MONTHLY and others interested in seeing just rewards received by every inventor whose products benefit the world. Everyone can help.

"Plant Pill" Gives Giant Yield

(*Continued from page 26*)

tions, it was found this spring that three heads of lettuce could be grown in the space given to two in most gardens, with an increase of 75 to 125 percent in size of heads, while hardiness of plants was increased to the point where loss by death of young lettuce was only four percent, as compared with an average of sixteen percent. Lettuce and other vegetables were grown in soil other than sand by ridging, application of the artificial alkali or hardpan to the trenches between the ridges, and then the slow flowing of the plant pill solution down shallow trenches in the ridges. The lettuce, carrot, beet, turnip, and other seeds were first soaked in the plant-pill liquid and then planted in these shallow trenches on top of the ridges.

PROBABLY the most important commercial gain shown, however, was in the production of sugar cane and beets. In the latter, crops of 175 tons to the acre—at least fifty tons more than hitherto produced—were made, with a slight increase in saccharine content and with a softer, less fibrous root, easier to reduce to sugar and materially larger than the average sugar beet now grown. Sugar cane, though not given as extensive trials as other vegetables due to lack of exactly suitable surroundings, showed two to three times the rate of growth made under normally favorable conditions, a slightly greater saccharine content, and larger, thicker, and heavier stalks, tending to the production of more sugar to each plant. The important point in the sugar cane experiments seems to be the greater rapidity of growth, so that more crops of the plant can be grown to greater size in a given period.

Interesting experiments were made with wheat in which larger grains, more grains to the head, and larger heads were ripened in a shorter time. It was found that the flour from this wheat produced a better bread, containing more phosphorus, than any on the market. One of the largest milling companies on the Pacific coast is now at work with Dr. Gericke in experiments on thousands of acres of wheat fields in the Northwest, looking to the production of a flour of greater food value from wheat of materially increased yield and shorter growing period.

MANY thousands of dollars have been expended in the last ten years by the lumber companies of the Pacific Northwest in reforestation of large tracts with redwood, pine, and fir trees. With the use of the plant pill solution, two to three seedlings of either of these valuable trees may be grown in the nursery-space now accorded to one. Furthermore, the young trees so grown are as large at the end of one year as they are without the plant pill treatment at the end of two, and sometimes three, years. Time enough has not elapsed to learn whether the increased rate of growth persists after the seedlings are transplanted to their permanent homes on the mountain sides, but the taking off of one or two years in the nursery is a very valuable gain in the time of production of a new crop of lumber.

One man has placed commercial flower growing on a business basis with the plant pill in Oakland, California, but the pills are not yet on sale and probably will not be for another year.

With the true conservatism of the scientist, Dr. Gericke is holding the several formulas secret until such time as all have been completed, and the individual method of application to each kind of tree, cereal, vegetable, and flower perfected. When these objectives have been obtained, neither Dr. Gericke nor the University of California will permit exploitation of the discovery to the point at which it cannot be applied at minimum cost to every commercial agricultural product.

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Crooks Cured by Surgeons Knife

(*Continued from page 21*)

of depression. This condition is known as 'adenoma.'

"In the third group were gathered those with 'colloid goiter;' that is, an abnormal growth of the thyroid gland, caused by a deposit of supposedly *inert* material in the gland tissue. As a rule, this condition does not present obvious external symptoms, but it does produce a tendency to obesity.

"When we referred to the records of the crimes committed by these men, we found that in approximately seventy percent of the cases those in classifications one and two had committed crimes of violence; that is, murder, assault with intent to kill, manslaughter, or manslaughter from reckless driving.

"EVEN more important than this, we learned that *many of these men had records of similar, though lesser, crimes running back to boyhood years.* One man showed tendencies to this sort of crime at the age of eight. Had he been given the proper medical and surgical care when a child, his life could have been turned to usefulness, and society would have been saved the labor and expense of protecting itself from his criminal tendency.

Records of these three groups of prisoners in general showed that each suffers from an abnormal stimulation of some sort. It appears to be certain that this instability of their mental processes is due solely to maloperation of the thyroid gland.

"Five of these men, intractable and guilty of frequent attacks on other prisoners, were given treatment by operation. That is, the hyper-plastic or overdeveloped tissue and the adenomas (gland enlargement) were removed. All have shown marked improvement in behavior, their mental stability has increased, their tendency to impulsive action has been reduced, and it is strongly probable that they will leave the prison with minds more in accord with the processes of civilization, and more amenable to its limitations, than they ever have been.

"Another group of prisoners—not thyroid abnormals—was made up of men having a disorder of the pituitary gland, commonly diagnosed as being due to undersecretion of the anterior or forward lobe of this gland. It was learned from the records that more than eighty percent of these cases were 'sent up' for crimes of irresponsibility, such as forgery, embezzlement, bad-check passing, and petty theft.

"IT IS interesting to note that not one in this 'pituitary group' had committed any crime of violence.

"In daily life, these are the fat, good-natured men; irresponsible, usually living far beyond their means, always in need of money, and so abnormal in endocrinal condition that they follow the paths of least resistance. Yet they are extremely difficult to arouse to a fighting mood, and in their efforts to fulfill their desires, stop far short of violence of any kind.

"We found that, generally speaking, it was possible to modify in a marked degree the personalities of these men, giving them greater seriousness, making them more responsible, and fixing in their minds a stronger sense of their proper attitude toward their fellow men.

"We did this by administering what we found to be the proper combination of pituitary and other glandular extracts, which seem to act as catalyzers, or reagents in the distribution of the introduced pituitary substance."

Doctor Reynolds and Doctor Stanley also worked with a third group of prisoners, known as the "dys-gonads" (those having badly developed sex glands), involving two divisions, the homosexuals and the undersexed. Most of these are furtive, secretive, unaggressive, harmless men, but here and there arises one who suddenly becomes vicious, without apparent reason. The majority of them are in prison for crimes of perversion, yet there are thousands of persons of similar type in society, hiding their perversions to such an extent that they never have fallen foul of the law.

Treatment of this type by glandular extract produced demonstrable, highly beneficial results, and there is little doubt in the mind of Doctor Reynolds that the pervert and degenerate types may be returned a long way toward normalcy by this artificial restoration of the balance of the sex glands.

Thus, the three departments of crime—acts of violence, attacks on property, and perversion—have been given tests of five years and proved to have their source in unbalanced mentality, produced by abnormalities in the glands of internal secretion. Yet both Doctor Reynolds and Doctor Stanley, pioneers and leaders in this study of glandular criminology, insist that the results obtained be regarded only as "experimental."

"OF THE prisoners examined, numbering hundreds, eighty-five percent had a definite history of disorder of the endocrine glands in one or both parents," continued Doctor Reynolds. "Similar abnormal conditions of these glands were found in grandparents, uncles, aunts, sisters, and brothers of these men.

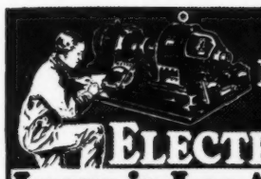
"This points clearly to a powerful hereditary factor at work in disorders of the glands of internal secretion.

"It points also to the more illuminating truth that if the grandparents, or even the parents, of these men had been given proper medical and surgical treatment for their own glandular abnormalities, their children and their grandchildren would not have offended society, and would not now be in prison, burdens on that civilization whose rules they have broken because of the upsetting of their endocrinal gland balance.

"Beyond this somewhat scientific deduction, we are met squarely with the tremendous economic and sociological fact that if we remove the endocrine abnormalities from the children of today, we shall reduce greatly the crimes against the society of tomorrow. If we restore the balance of the thyroid gland in the throat of little Johnny Jones, thereby calming permanently his childish outbursts of temper, we are in a fair way to prevent a murder. If we train wee Billy Smith's pituitary glands so that he refrains from stealing his neighbor's apples, we have curbed the malsecretion of the gland which has put other and older men into prison for embezzlement and forgery.

"WE ARE becoming more and more certain that behind every 'backward' and 'wayward' child there is a *physical* reason. Something is wrong with the internal mechanism, the glandular chemistry, of that child's body. If, through a study of the child's endocrinal history, and a complete examination of its present condition, we can restore the balance of the gland influence on the child's mentality, then we can remove what we call, for want of a better term, the 'tendency to crime.'"

So much for the prevention of crime, for the averting, in youth, of a predisposition toward wrongdoing in later years. We have seen what Doctor Reynolds and Doctor Stanley have accomplished with the adult criminal in San Quentin prison. The logical path along which this work must go is the one of restoring to these men such mental balance that they will realize their responsibilities to themselves, to society, and to civilization. Doctor Reynolds believes that this can be done in many instances, but his demand (*Continued on page 133*)



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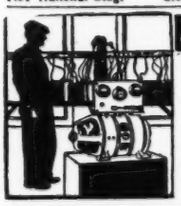

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Crooks Cured by Surgeon's Knife

(Continued from page 132)

is for time to observe the result of experimental surgical and medical work done on these prisoners.

Let Doctor Reynolds speak again:

"We have with us another and larger group which has been only touched in this study of glandular balance and control. These are the persons who, we say casually, 'have criminal faces'; scientifically, they are classified as having the stigmata of degeneration. Their facial abnormalities—from the sight of which the layman judges them to be at least potential criminals—are due to disturbances in growth and development. Endocrinologists, specialists in the study and treatment of endocrine glands, have come to look upon them as glandular subjects, inasmuch as virtually always their ancestry reveals a long and involved history of disarrangement of the glands of internal secretion.

"IN THE ancestry of such persons also appear insanity, epilepsy, feeble-mindedness, cataracts early in life, harelip, strabismus (commonly known as 'cross-eye'), and other defections from the normal, scientifically classified as 'stigmata.' Their histories often begin with a parent who, for example, had a pituitary abnormality, from which only other pituitary disarrangements will appear in the children for several generations. Then, quite suddenly, in one of these generations, the offspring *will begin to show other defects in development,* abnormalities of mind as well as of body.

"Often these 'degenerations' are not accompanied by any of the recognizable symptoms of gland disorders, and it is *only from their histories that the true causes of their conditions, their physical, mental, and moral aberrations, may be obtained.* For this reason medical science has been slow to accept the close relationship which undoubtedly exists between the 'man with the criminal face' and glandular disarrangements.

"If the earlier stages of gland disorder are diagnosed and treated, much can be accomplished, but when the hereditary process has reached the point— several generations later—of pronounced stigmata of degeneration, segregation of these individuals seems to be the only method of eliminating their spread. Low fecundity and early death combine to wipe out this type, *if so isolated that new blood cannot be brought in by marriage.*

"OF ALL the types in our penal and corrective institutions, these seem to be the ones whose segregation and confinement is necessary until they die out, in spite of all that has been or can be done for them in the way of effort to restore their mental and physical stability by gland treatment.

"In the near future, large groups of prisoners at San Quentin and other penal institutions are to be *classified as to the type of crime committed,* and then studied *as to the glandular disturbance* which preponderates in each group. On the determination of the extent to which criminal tendencies can be reduced by restoration of the endocrine gland balance rests the greatest hope of modern society for the prevention of crime in future generations, and the reformation—or, better, the 'remaking'—of the criminal in this generation."

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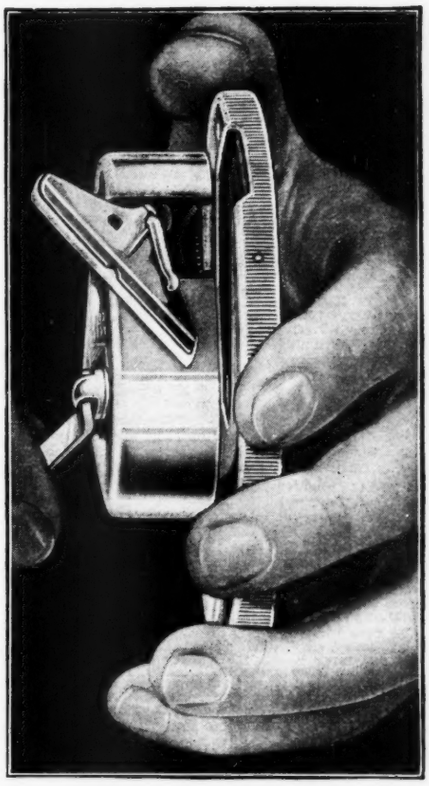

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Why Your Fireworks Flash and Go Boom

(Continued from page 39)

the open, they fizz and burn like very fast and brilliant colored fire. When the slow-burning powder of the Roman candle ignites them, they take fire all over at once. The flame ignites a charge of quick-firing powder behind the star. "Plop!" Out goes the ball of colored fire.

Thus I watched the workman drop alternate charges of fast powder, balls, and slow powder into two rows of Roman candles clamped in a stand. After dropping in each a measured charge, he twirled a handle that brought down brass plungers and packed in the powder of every candle at once.

TWO of the plant's most important men collaborate in making Roman candles, as well as many other pieces—the "color man" and the "composition man." The first has complete charge of the making of stars and any other effects that contain color. Every year he works out new tints. He is a fireworks expert rather than a chemist, for chemistry does not always help in this game. For example, salts of copper give flames a green color in a chemist's laboratory. In good fireworks practice, they are actually used to make blue fire. The fireworks man produces green by mixing the salt of another metal, barium, with his powder. Red is obtained with salts of strontium. Through the research of many a factory's color man, "safe colors" have been introduced during recent years that are proof against going off prematurely in the factory—a former defect of the fastburning materials used in colored fire mixtures for stars.

The "composition man" directs the making of every variety of powder, called "composition" by fireworks makers. Most fireworks powders are based on the original ingredients of "black powder," of which one form is gunpowder; that is, saltpeter, sulphur, and charcoal. But a good composition man can vary the proportions, in ways that he keeps a jealous secret, to produce at will so slow a powder that it serves as a fuse in a Roman candle or so fast and violent that it bursts a rocket in mid-air. Too, he knows how to add such things as metal filings, perhaps to give a rocket a brilliant, cometlike tail.

Fireworks makers are generally proudest of their skyrockets and their bombshells. Here is the best opportunity for them to use their ingenuity in producing unusual effects.

All skyrockets have the same driving mechanism. The body of the rocket is crammed with a medium-burning powder, under tremendous pressure. I saw a workman turn a valve, and brass hydraulic plungers rammed in the powder under a thousand pounds' pressure. It was forced around a spindle in the rocket case. Removing the spindle leaves a hole extending far into the case. When a fuse ignites the powder, it takes fire all along the surface of the hole at once.

THE rocket goes hissing into the air under the recoil from the gases of combustion, which rush from a constricted opening at its base. During ascent, the powder burns nearer and nearer the head. Just as the rocket passes the apex of its flight and begins to drop, if the composition man has timed his powder well, the flame reaches the top and flashes over into the head of the rocket. Instantly a charge of "bursting powder" explodes.

What happens then depends upon the imagination of the designer. If he has filled the head with stars, beautiful balls of colored fire are scattered in all directions. Perhaps, instead, a parachute opens and lowers a brilliant flare. Or the head, exploding, may shoot out other rockets in relay fashion.

Even more varied are bombs, projectiles which are shot from mortars buried in the ground. The bottom of the bomb contains a charge of explosive that hurls the rest high in the air. There a time fuse explodes it with a loud report. Out may come hissing "snakes," "dragons," or balls of colored fire. A Japanese variety used in daylight scatters cloth parachutes, grotesquely shaped to resemble figures of animals. One bomb may be divided into separate partitions and give several displays successively. This plant's proud record is twenty-one in one bomb.

An unusual bomb order the Staten Island plant once received was from a malted milk concern. This firm planned to advertise its product with fireworks bombs at country fairs. When the bomb exploded, it was to unfurl an illuminated banner bearing a cow's picture with the name of the firm's product on it.

That was easy for the fireworks men. To be sure just how far away the banner could be read—one, two, or three miles—they sent up test bombs at night from the Staten Island plant. Every week Staten Islanders, hearing a loud report, would look aloft and see some strange device floating in the air. For the tests, no one cared what message the banners carried. So an astonished audience would see a banner bearing the cryptic message "D-O-G," or "C-A-T," or whatever the man who prepared the banner was moved to write. The cow, by the way, was a big success.

MOST elaborate of all are the set-pieces, which display a huge picture traced in fire. The subject may be anything from President Hoover's portrait to Niagara Falls.

If a portrait of a person is to be constructed, the first step is to obtain a photograph. With the aid of a machine known as a pantograph, an enlarged tracing is made of the picture. The result is an outline drawing perhaps six by ten feet, and this is evenly ruled into squares.

In the meantime carpenters have built a latticelike frame of equal size, the lattices of which correspond in spacing to the squares on the picture. Now, using the picture as a guide, strips of flexible rattan are nailed to the lattice, bent to form the outlines of the picture. When this is completed, the latticework bears the finished picture in strips of rattan.

The last step is to attach the fireworks. To illuminate the picture hundreds, or even thousands, of "lances" are attached to the rattan at four, five, or six-inch intervals. The lances are torches of colored fire about the size of a pencil, stuck endwise against the rattan. Fuses are attached, connecting the lances. When the fuse is finally touched off the entire piece becomes a dazzling portrait in colored fire.

When such set-pieces are a part of a public fireworks display, they must be put up with an eye to the weather. A little rain would put one out of commission in a jiffy. A good fireworks man must be a weather prophet, and if rain threatens he will postpone the actual attachment of the fireworks until a short time before the show.

A fireworks plant is not solely concerned with the Fourth of July. Other events are celebrated by fireworks; for example, Christmas and New Year's in the South. Yet I was surprised to learn that fully two-fifths of a fireworks company's business comes from sources in no way connected with the observance of holidays.

All railroad trains, for example, are required by law to carry fusees—red flares which brakemen place at the rear of a stalled train to avert rear-end collisions. To pass the official tests, they must *(Continued on page 135)*

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Why Your Fireworks Flash and Go Boom

(*Continued from page 134*)

light immediately after having been soaked for ten minutes in a pail of water. The test is severe, because on a railroad they must not fail despite rain, snow, or hail.

The rockets and flares used as signals in shipping, aviation, and military maneuvers are products of the fireworks factories. Surveyors in difficult country also use them. When an impassable marsh is encountered, for example, a rocket sent up on one side permits taking a sight from the other.

Since the flight of a rocket-propelled airplane in Germany, I was told, fireworks manufacturers have been besieged by inventors who want rockets built for their flying machines and other vehicular creations.

A practical use of fireworks in aviation is in starting airplane motors. Special cartridges have been worked out that can be inserted in one cylinder of a motor, fitted to the spark plug. A crank of the plane's "booster" magneto, and the exploding cartridge spins the motor and eliminates hand cranking.

You Can't Save Gas with Gadgets

(*Continued from page 74*)

mixture, so almost anything that will add a little bit more air will cut down the gasoline used. Of course, they'd get better results by adjusting the carburetor for a leaner mixture without bothering with any extra gadget."

"Isn't there anything to this idea of adding extra air to the manifold?" asked Southby.

"There is," said Gus, "but not by any automatic device. If you want to go to the trouble of fitting a valve in the manifold between the carburetor and the cylinder block and arranging a hand control so that you can open or close it while you are driving the car, you can run up the gas mileage and also cut down the carbon deposit some."

"Why couldn't they produce an automatic device to do the same thing?" asked Southby.

"Perhaps they could," said Gus, "but all the carburetor experts in the world haven't been able to do it yet. If you want, I'll adjust your carburetor for a thin mixture, but you won't be able to climb hills quite so well as you can with a thick mixture."

"Aw, forget it," said Southby, "I'd rather use more gas and get up the hills easier."

Putting a Radio in Your Car

(*Continued from page 72*)

The commutator brushes of the generator also produce a series of minute sparks and consequent high frequency oscillations which get into the radio circuit either by radiation from the car wiring to the antenna or directly by way of the filament wires that carry the A current to the set. A condenser of one or two microfarads capacity connected across the wire that delivers power from the generator, as close to the generator as possible and with the other terminal connected to the frame, will suppress the major portion of this disturbance.

Of course, it is obvious that any sensitive five or six tube battery operated receiver of standard type designed for home reception can be used as an automobile radio if the interference methods already outlined are carried out and space can be found for the set somewhere in the car.

It is unfair to expect the tone quality obtainable from an automobile radio set to equal that to be had from a good home radio set.

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* * *

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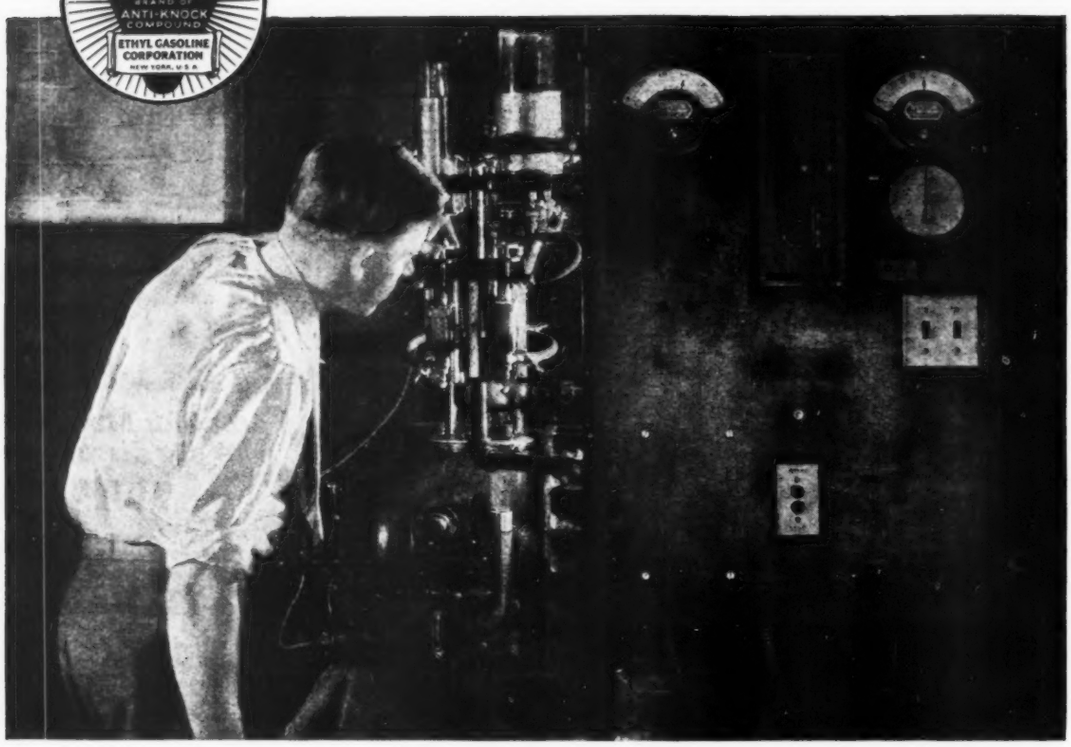

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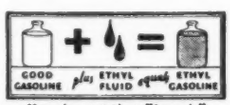

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